RECORD OF DECISION

STAR LAKE CANAL
SUPERFUND SITE

TX0001414341
PORT NECHES, TEXAS

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION 6

September 2013

693085

017985

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ABBREVIATIONS AND ACRONYMS

AVS	Acid volatile sulfides
AOC	Administrative Order on Consent
AOI	Area of Investigation
ATSDR	Agency for Toxic Substances and Disease Registry
ARARs	Applicable or Relevant and Appropriate Requirements
BERA	Baseline ecological risk assessment
COC	Chemicals of concern
CEMC	Chevron Environmental Management Company
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CIP	Community Involvement Plan
COPC	Contaminant (chemical) of potential concern
COPEC	Contaminants (chemical) of potential ecological concern
CCA	Copper chromated arsenic
DD#7	Jefferson County Drainage District #7
DHHS	Department of Health and Human Services
ERM-Q	Effect range medium quotient
ELCR	Excess lifetime cancer risk
EPA	U.S. Environmental Protection Agency (Region 6)
EPC	Exposure point concentration
ESI	Expanded Site Inspection
FR	Federal Register
FS	Feasibility study
HI	Hazard index
HQ	Hazard quotient
$HQ_{[LOAEL]}$	Hazard quotient based on the Lowest-Observed Adverse Effects Level
HHRA	Human health risk assessment
Huntsman	Huntsman Petrochemical LLC
IC	Institutional control
IRIS	Integrated Risk Information System
IARC	International Agency for Research on Cancer
kg	Kilogram
KH	Henry's Law constant
LNVA	Lower Neches Valley Authority
LOAEL	Lowest observable adverse effects level
µg/L	Microgram per liter
mg	Milligram
mg/kg	Milligram per kilogram
mg/L	Milligram per liter
MNR	Monitored Natural Recovery
NCEA	National Center for Environmental Assessment
NOAA	National Oceanic and Atmospheric Administration
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NGVD	National Geodetic Vertical Datum

ABBREVIATIONS AND ACRONYMS (Continued)

NPL	National Priorities List
NOAEL	No observable adverse effects level
O&M	Operation and maintenance
PAH	Polycyclic aromatic hydrocarbons
PCB	Polychlorinated biphenyl
PCL	Protective concentration level
PEL-Q	Probable effect level quotient
RCRA	Resource Conservation and Recovery Act
ROC	Receptors of concern
ROD	Record of Decision
RfD	Reference doses
RG	Remedial Goals
RI	Remedial investigation
RI/FS	Remedial investigation and feasibility study
RME	Reasonable maximum exposure
RAO	Remedial action objectives
RBEL	Risk-Based Exposure Limits
SDWA	Safe Drinking Water Act
SLERA	Screening level ecological risk assessment
SVOC	Semi volatile organic compounds
SEM	Simultaneously extractable metals
SEM/AVS	Simultaneously extractable metals and acid volatile sulfides ratio
SF	Slope factor
SSI	Screening Site Inspection
TBC	To be considered
TPH	Total petroleum hydrocarbons
TU	Toxic Unit
TCEQ	Texas Commission on Environmental Quality
TDWR	Texas Department of Water Resources
TNRCC	Texas Natural Resource Conservation Commission (currently TCEQ)
TPDES	Texas Pollutant Discharge Elimination System
TRRP	Texas Risk Reduction Program
TRV	Toxicity Reference Value
TSCA	Toxic Substances Control Act
TSWQS	Texas Surface Water Quality Standards
TWDB	Texas Water Development Board
TMV	Toxicity, mobility, or volume
95% UCL	95% Upper confidence limit
USC	United States Code
UTL	Upper trophic level
VOC	Volatile organic compounds

PART 1: THE DECLARATION

1.0 SITE NAME AND LOCATION

The Star Lake Canal Superfund Site (Site) is located in Jefferson County, in and around the cities of Port Neches and Groves, Texas. The site has been divided into seven Areas of Investigation (AOI): Jefferson Canal, Jefferson Canal Spoil Pile, Former Star Lake, Star Lake Canal, Gulf States Utility Canal, Molasses Bayou Waterway, and the Molasses Bayou Wetland. The site location and the boundaries of the seven AOIs are shown in Figure One and Figure Two. The Site is defined as the lengths of the two industrial canals from their origins to the confluence of Star Lake Canal with the Neches River and the adjacent wetlands. The straight-line distance along Star Lake Canal from its origin east of the intersection of Highway 136 and FM 366 to its confluence with the Neches River is approximately 16,500 feet. The straight-line distance along Jefferson Canal from its origin on the east side of Hogaboom Road south of FM 366 to its confluence with Star Lake Canal north of the Hurricane Protection Levee is approximately 4,000 feet. Molasses Bayou is located southeast of the Star Lake Canal and intersects the canal in two locations. The Gulf States Utility Canal is a canal that resulted during the recent placement of a buried utility line and is located parallel to and approximately 100-200 feet northwest of the Star Lake Canal. The Gulf States Utility Canal extends from the Neches River to a point approximately 500 feet downstream from Sara Jane Road.

2.0 STATEMENT OF BASIS AND PURPOSE

This decision document presents the Selected Remedy for the Star Lake Canal Superfund Site in Jefferson County, Texas. The Selected Remedy was chosen in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), 42 U.S.C. § 9601 et seq., as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) Part 300, as amended. This decision is based on the Administrative Record file for the Site. The Selected Remedy for the Site is as follows:

- Jefferson Canal: Alternative 3b - 12-inch Removal/Disposal and Containment in certain areas.
- Jefferson Canal Spoil Pile: Alternative 2b - Removal/Disposal of mounds to grade and Containment with a two-foot composite cap.
- Former Star Lake: Alternative 2b - 12-inch Removal/Disposal and Containment in certain areas.
- Star Lake Canal: Alternative 2 – 12-Inch Removal/Disposal and a 12-inch Clay Cap.
- Gulf States Utility Canal: Alternative 2 – Containment with a 12-inch Composite Cap.
- Molasses Bayou Waterway: Alternative 2b - Monitored Natural Recovery (MNR) in certain areas; 12-inch Removal/Disposal and a 12-inch Armored Cap in other areas.
- Molasses Bayou Wetland: Alternative 2b - MNR in certain areas and a 12-inch Composite Cap in other areas.

The Selected Remedies are described in detail in Section 19 (Description of the Selected Remedy) of this ROD.

This decision is based on the Administrative Record for the Site, which has been developed in accordance with Section 113(k) of CERCLA, 42 U.S.C. § 9613(k). This Administrative Record file is available for review at the Port Neches Effie & Wilton Hebert Public Library, 2025 Merriman Street Port Neches, Texas 77651, (409) 722-4554; and at the Texas Commission on Environmental Quality (TCEQ) Central File Room in Austin, Texas. The Administrative Record Index (Appendix B) identifies each of the items comprising the Administrative Record upon which the selection of the Remedial Action is based.

The State of Texas (TCEQ) concurs with the Selected Remedy.

3.0 ASSESSMENT OF THE SITE

The response action selected in this Record of Decision (ROD) is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

4.0 DESCRIPTION OF THE SELECTED REMEDY

The response action selected in this Record of Decision is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment. The Selected Remedy includes containment to provide a barrier between contaminated material remaining and biological receptors (i.e., benthic invertebrates and upper trophic receptors), and/or removal/disposal of contaminated materials followed by the use of containment, and take into account the current and reasonably anticipated future land use. Monitored natural recovery is also a part of the Selected Remedy. The Selected Remedy for each of the seven areas being addressed by this ROD are as follows:

- **Jefferson Canal:** Alternative 3b - 12-inch Removal/Disposal and Containment in certain areas. All sub-areas of interest (JC-2, JC-7, JC-13, JC-18, and JC-19) will be excavated. Excavation activities will remove the top 12 inches within sub-areas except within pipeline servitudes, which will maintain a 25 foot boundary with no excavation to ensure pipeline security. Following excavation, a 12-inch soil cap will be placed on areas outside of the pipeline servitude and a 12-inch erosion control mat will be placed on the pipeline servitude. An erosion control mat consists of a lightweight aggregate contained within a polymer mesh exterior. Removed material will be transported for disposal at an approved waste treatment facility.

- **Jefferson Canal Spoil Pile:** Alternative 2b - Removal/Disposal of mounds to grade and Containment with two-foot composite cap. Cap composition will consist of a 12-inch layer of clay to inhibit infiltration, overlaid with a 12-inch layer of top soil to allow for vegetative stabilization. Removed material will be transported for disposal at an approved waste treatment facility.

- **Former Star Lake:** Alternative 2b - 12-inch Removal/Disposal and Containment in certain areas. Following excavation of the top 12 inches in certain areas, a clay cap will be placed on areas outside of the pipeline servitude. Inside the pipeline servitude, a 12-inch composite cap or a 12-inch erosion control mat if the area is on the banks of Star Lake Canal will be placed. The hydraulic capacity of the Star Lake Canal will not be modified. Removed material will be transported for disposal at an approved waste treatment facility.

- **Star Lake Canal:** Alternative 2 – 12-Inch Removal/Disposal and a 12-inch Clay Cap. Following excavation of the top 12 inches in certain areas, a 12-inch clay cap will be placed to provide a barrier

between contaminated sediment and benthic invertebrates. The hydraulic capacity of the canal will not be modified. Removed material will be transported for disposal at an approved waste treatment facility.

- **Gulf States Utility Canal:** Alternative 2 – Containment with a 12-inch Composite Cap. A 12-inch thick composite cap will be installed in certain areas. The composite cap will consist of a 6-inch clay layer covered with a 6-inch topsoil layer.

- **Molasses Bayou Waterway:** Alternative 2b - MNR in certain areas, and 12-inch Removal/Disposal with a 12-inch Armored Cap in other areas. MNR will be applied to certain areas of the waterway. MNR will remediate contamination through various naturally occurring processes including chemical/physical transport and degradation, biological degradation, and physical burial. Following excavation of the top 12 inches in certain other areas, a 12-inch armored cap will be installed. The armored cap will consist of a layer of cobbles, pebbles, or other large material. Removed material will be transported for disposal at an approved waste treatment facility.

- **Molasses Bayou Wetland:** Alternative 2b - MNR in certain areas and a 12-inch Composite Cap in other areas. MNR will be applied to certain areas of the wetland and will remediate contamination through various naturally occurring processes including chemical/physical transport and degradation, biological degradation, and physical burial. The composite cap will consist of a 6-inch clay layer covered with a 6-inch topsoil layer.

5.0 STATUTORY DETERMINATIONS

The Selected Remedy is protective of human health and the environment, complies with Federal and State requirements that are applicable or relevant and appropriate to the remedial action, is cost-effective, and utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable. This remedy does not satisfy the statutory preference for treatment as a principal element of the remedy (i.e., reduces the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants as a principal element through treatment). However, there is no unacceptable risk to human health at the Site, and the disposal of the removed contaminated material at an approved offsite waste treatment facility will result in a reduction of the mobility and volume of the material at the Site. Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within five years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

6.0 DATA CERTIFICATION CHECKLIST

The following information is included in The Declaration (Part 1) and the Decision Summary (Part 2) of this ROD, while additional information can be found in the Administrative Record file for this Site:

- Chemicals of concern (COCs) and their respective concentrations (see Section 15 and Table 1);

- Baseline risk represented by the COCs (see Section 14);

- Cleanup levels established for chemicals of concern and the basis for these levels. (see Section 15);

- How source materials constituting principal threats are addressed (see Section 18.0);
- Current and reasonably anticipated future land use assumptions used in the Baseline Human Health Risk Assessment and this ROD (see Section 13.0).
- Potential land use that will be available at the Site as a result of the Selected Remedy (see Section 13.0);
- Estimated capital, annual operation and maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected (see Section 17.2.8 and 17.2.9);
- Key factor(s) that led to selecting the remedy (see Section 19).

7.0 AUTHORIZING SIGNATURE

The Director of the Superfund Division (EPA, Region 6) has been delegated the authority to approve and sign this ROD.

U.S. Environmental Protection Agency (Region 6)

By: _____ Date: 9/30/13

Carl Edlund, Director
Superfund Division (6SF)

PART 2: THE DECISION SUMMARY

8.0 SITE NAME, LOCATION, AND BRIEF DESCRIPTION

The National Superfund Database Identification Number for the Site is TX0001414341. The Star Lake Canal Superfund Site is located in Jefferson County, in and around the cities of Port Neches and Groves, Texas. Port Neches is located in southeast Texas, approximately 88 miles east of Houston, Texas. Other communities in the area include Nederland, and Port Arthur.

The Site has been divided into seven AOIs: Jefferson Canal, Jefferson Canal Spoil Pile, Former Star Lake, Star Lake Canal, Gulf States Utility Canal, Molasses Bayou Waterway, and the Molasses Bayou Wetland. The Site location and the boundaries of the seven AOIs are shown in Figure One and Figure Two.

The Site is defined as the lengths of the two industrial canals from their origins to the confluence of Star Lake Canal with the Neches River and the adjacent wetlands. The straight-line distance along Star Lake Canal from its origin east of the intersection of Highway 136 and FM 366 to its confluence with the Neches River is approximately 16,500 feet. The straight-line distance along Jefferson Canal from its origin on the east side of Hogaboom Road south of FM 366 to its confluence with Star Lake Canal north of the Hurricane Protection Levee is approximately 4,000 feet. The canals receive storm water and permitted discharge of effluent by some of the surrounding industry.

The Molasses Bayou Waterway is located southeast of the Star Lake Canal and intersects the canal in two locations. The Molasses Bayou Waterway is contained within the Molasses Bayou Wetland, which is adjacent to the Star Lake Canal. The Gulf States Utility Canal is a canal that resulted during the recent placement of a buried utility line and is located parallel to and approximately 100-200 feet northwest of the Star Lake Canal. The Gulf States Utility Canal extends from the Neches River to a point approximately 500 feet downstream from Atlantic (also known as Sara Jane) Road.

A large portion of the Star Lake Canal watershed is dominated by commercial and industrial land use. The primary habitat at the Site is open water canals and bayous bordered by emergent wetlands.

The area is occasionally subject to tropical storms and hurricanes. The National Weather Service (NWS) indicates that a tropical storm passes through the area about once every 1.6 years. A hurricane passes through the area every 3.3 years and a major hurricane every 14 years. The water surface elevation at the Site is influenced by the stage in the Neches River near its confluence with Sabine Lake. The elevation of surface water at the Site is dependent upon the stream flow in the Neches River and the effect of tidal fluctuation in the Gulf of Mexico.

Drinking water in the area of the Site is supplied by the Lower Neches Valley Authority whose surface water intake locations are north and upstream of the area, in the City of Beaumont.

The EPA is the lead agency for the Site remedial action selection and cleanup activities, and the Texas Commission on Environmental Quality (TCEQ) is the support agency. The source of monies for the Remedial Investigation/Feasibility Study (RI/FS) is the Potentially Responsible Parties, who are currently Chevron Environmental Management Company (CEMC) and Huntsman Petrochemical LLC (Huntsman).

9.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

This section of the ROD provides the history of the Site and a brief discussion of the EPA's and the State's removal, remedial, and enforcement activities.

9.1 History of Site Activities

In 1901, the petroleum industry moved into the area, and a community on the banks of the Neches River, known as Grigsby's Bluff, became Port Neches. The city is currently surrounded by large industry. Major employers include Huntsman, Premcor, Motiva, and Mid-Jefferson Hospital.

Industrial operations have occurred in the area surrounding the site since the early 1940s, and continue to the present date. Initial construction of industrial facilities occurred under the direction of the United States government during World War II, and subsequent operations have continued through the present. Jefferson Canal and Star Lake Canal were excavated in the late 1940s to receive storm water and industrial waste water. Star Lake and Jefferson Canals have been used by the surrounding industry for discharge of industrial effluents. Historical unpermitted discharges have resulted in the deposition of a number of chemicals at the Site.

Currently, industrial discharges to Star Lake Canal (including the Huntsman, Ashland, and TPC facility discharges) are treated in the Joint Wastewater Treatment Plant located in the Huntsman facility in accordance with a Texas Pollutant Discharge Elimination System permit. The effluent from the only other industrial facility in the area, the Calabrian facility, is discharged into the Star Lake Canal also in accordance with a Texas Pollutant Discharge Elimination System permit. The discharges from the Joint Wastewater Treatment Plant are further treated in a constructed wetland located within the Huntsman facility to polish the effluent prior to discharge into the Star Lake Canal. There are no routine industrial discharges into Jefferson Canal other than bypasses that may occur during significant rainfall events. Any such bypasses are sampled and reported, however, such bypasses are rare. Therefore, it is not likely that the Site would receive additional significant contamination as a result of future industrial discharges.

In 1983, the Jefferson County Drainage District Number 7 (DD #7) dredged the Jefferson Canal by dragline after acquiring an easement on the canal from Texaco Chemical Company. The DD #7 deposited dredged materials onto the banks of Jefferson Canal in and around an area south of FM Road 366.

A large portion of the Star Lake Canal watershed is dominated by commercial and industrial land use. There are no surface water uses and no drinking water intakes at the Site. There are no public ground water wells within a four mile radius, and the one private groundwater well in the vicinity is up-gradient of the Site.

9.2 History of Federal and State Investigations and Removal/Remedial Actions

Texas investigations conducted during the 1970s focused on pentachlorophenol and toxaphene constituents in the Jefferson Canal sediment. In 1983, sediments impacted with toxaphene were identified that may have been dredged from the canal and placed on its banks. In 1983, an analytical report from a single sample of disposed dredged material revealed concentrations of toxaphene, acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(p)pyrene, benzo(b)fluoranthene, chrysene, fluoranthene, fluorene, naphthalene, phenanthrene, pyrene, and biphenyls above the laboratory detection limits.

On March 21 and March 23, 1983, the Texas Department of Water Resources (TDWR) collected sediment samples from Jefferson Canal, dredged spoil samples from the banks of Jefferson Canal, and made observations on rainfall and runoff from the dredged materials. Samples were noted to have a strong aromatic odor characteristic of phenolic compounds. The TDWR inspection also revealed rainfall and runoff from dredged materials along the Jefferson Canal bank entering Jefferson Canal. A further review of state records indicated that sampling of dredged materials from Jefferson Canal sediments documented the presence of concentrations of polycyclic aromatic hydrocarbons (PAHs) including naphthalene, acenaphthylene, fluorene, phenanthrene, anthracene, pyrene, benzo(a)anthracene, benzo-b-fluoranthene, benzo(a)pyrene, benzo-a-fluoranthene, and chrysene at concentrations above the laboratory detection limits. Soil on property adjacent to the Jefferson Canal was found to contain toxaphene and possibly pentachlorophenol at concentrations above the laboratory detection limits.

The TNRCC (presently TCEQ), on behalf of the EPA Region 6, performed a Screening Site Inspection (SSI) at the Site during the pre-remedial investigation stage of the Superfund process. During the investigation, 19 sediment samples were collected, including three background sediment samples from near the Neches River. The objective of the SSI was to identify the constituents present, assess whether a release of hazardous substances had occurred, and look for evidence of potential human and environmental exposures to constituents. The SSI Report of the Star Lake Canal, dated September 1997, indicated that the following constituents were detected in samples collected from the Jefferson and Star Lake Canals above the laboratory detection limit: acenaphthene, acenaphthylene, anthracene, arsenic, barium, benzo(b)fluoranthene, benzo(k)fluoranthene, cyanide, fluoranthene, fluorene, mercury, 2-methylnaphthalene, naphthalene, aroclor-1254 (a polychlorinated biphenyl [PCB]), phenanthrene, pyrene, and thallium. A table of organic constituents in the samples contained a hand-written entry that indicated that benzo(a)anthracene, chrysene, and benzo(a)pyrene were also detected.

The TNRCC (presently TCEQ), on behalf of the EPA Region 6, performed an Expanded Site Inspection (ESI) of the Site. The ESI was conducted to further investigate and document the potential presence of hazardous substances that might have migrated from Jefferson Canal to the rest of the Site. The focus of the ESI was based upon results obtained during the SSI (1997). The potential source areas, as defined in the ESI, were the impacted sediments of the Jefferson Canal, Star Lake Canal, and the left prong of Molasses Bayou. In March 1998, 26 sediment samples, including five background sediment samples from near the Neches River, were collected. The ESI Report, dated January 1999, included other constituents not listed in the 1997 SSI report, including: acetone, aldrin, benzene, benzo(g,h,i)pyrelene, chromium, copper, 4,4'-DDD, endosulfan I, ethylbenzene, heptachlor epoxide, indeno(1,2,3-cd)pyrelene, selenium, silver, styrene, toluene, and total xylenes. However, arsenic, barium, cyanide, and mercury previously reported in the 1997 SSI report were not reported in the ESI.

On July 22, 1999, the EPA proposed the addition of the Star Lake Canal Site to the National Priority List (NPL). On August 28, 2000, and pursuant to Section 105 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, 42 U.S.C. § 9605) the Site was added to the NPL (40 C.F.R. Part 300, App. B).

No previous remedial or removal actions have been completed at the Site.

9.3 History of CERCLA Enforcement Activities

On December 22, 2005, EPA, CEMC and Huntsman signed an Administrative Order on Consent (AOC) to perform a Remedial Investigation and Feasibility Study (RI/FS) at the Site.

Regarding concurrent regulatory actions, Huntsman is conducting a ground water corrective action monitoring program at their Port Neches Performance Products (PNPP) facility under the TCEQ Site-Wide Groundwater Corrective Action Monitoring Program. The PNPP facility is not a part of the Site, although former historic PNPP effluent discharges did contribute to Site contamination. The groundwater plume originated from the PNPP facility and not from the Site, although the plume does underlie a portion of the Site. The objective of the groundwater monitoring program is to document the vertical and horizontal extent of the existing groundwater plume, which is not a part of the Star Lake Canal Site. The Corrective Action Monitoring Program will also monitor the effectiveness and progress of naturally occurring biodegradation processes that are attenuating and degrading the COCs in the groundwater within the two uppermost water-bearing zones beneath the PNPP facility.

10.0 COMMUNITY PARTICIPATION

In 1999, to evaluate community health concerns, the Agency for Toxic Substances and Disease Registry (ATSDR) mailed letters to residents living along Sara Jane (Atlantic) Road adjacent to Star Lake Canal. The letters explained that the ATSDR was evaluating sediment data in order to determine whether chemicals in the sediment pose a public health threat, asked if they had any concerns pertaining to the Site, and asked them to respond by phone or mail. The ATSDR received two responses, both of which stated that they had no health concerns related to the chemicals in Star Lake Canal.

As part of the research for preparation of the Community Involvement Plan (CIP), EPA staff discussed community issues, concerns and information needs related to the Site during personal interviews conducted during the last week of October 2002 with public officials who live and work in the community. The community interviews provided these interested citizens with opportunities to ask questions, voice their opinions and concerns about Site activities and issues, and learn more about the Superfund program. In addition to the community interviews, EPA project staff has gained insight into perceptions about the Site from ongoing contact with community members over the course of the project. The following summarizes the results of these community interviews.

- The Star Lake Canal has been listed on the National Priorities List since 2000, and interviewees said most nearby residents probably will not be overly concerned about potential contamination affecting the Canal. However, those who fish and crab in the Canal could become very concerned if contaminants are discovered at levels that could threaten this activity.
- Interviewees were interested in learning more about what potential risks the Site could pose, what types of contaminants might be present and at what concentrations. They all are hoping to avoid status as PRPs, and one interview participant expressed strong feelings on how Superfund liability is apportioned.
- Community members hold diverse opinions on environmental issues, and most organized environmental groups in the area focus their efforts on highly visible, well-funded industries. But any perceived potential impacts to wetlands, such as Bessie Heights Marsh, could potentially generate concern.
- Interviewees were uncertain if community members would react negatively to local industries that support the local economy being named as PRPs. One suggested that industries cited as PRPs might choose to blame EPA for economic problems they may be experiencing.
- Interview participants indicated that the most effective communication tools for informing residents about Site activities are community meetings, direct mail, and news stories and notices in the *Beaumont Enterprise*, *Port Arthur News*, and *Mid-County Chronicle*. Local television and radio

stations also were mentioned as good ways to reach community members. The City of Groves and City of Port Neches offered to use their media resources to help distribute open house announcements and other news, if needed. Huntsman has established an active Community Advisory Committee, and one interviewee thought this might be one avenue to reach community members with news about the Site.

The Remedial Investigation (RI) Report, the Feasibility Study (FS), and the Proposed Plan for the Site were made available to the public in June 2013. These documents can be found in the Administrative Record file and the information repositories maintained at the Effie & Wilton Hebert Public Library at 2025 Merriman Street in Port Neches, Texas, and at the Texas Commission on Environmental Quality Central File Room at 12100 Park 35 Circle, Building E, Room 103, in Austin, Texas. The notice of the availability of these documents was published in the Port Arthur News on June 21, 2013. In addition, a fact sheet providing information on the Site and the preferred alternatives was mailed to the community mailing list on June 21, 2013. A public comment period was held from June 21 to July 20, 2013. The EPA, with assistance from TCEQ, conducted a public meeting on July 11, 2013, to discuss the Proposed Plan and receive comments from the community. Prior to the public meeting, a reminder post card was mailed to the community mailing list on June 28, 2013. The public meeting was held at the Effie & Wilton Hebert Public Library at 2025 Merriman Street in Port Neches, Texas. These activities meet the community participation requirement of CERCLA 300.430(f)(3) and the NCP. In the Responsiveness Summary, EPA responded to all comments received during the public comment period. The Responsiveness Summary is included as part of this ROD.

11.0 SCOPE AND ROLE OF RESPONSE ACTION

The NCP, 40 CFR Section 300.5, defines an operable unit as a discrete action that comprises an incremental step toward comprehensively addressing a site's contamination problems. The cleanup of a site may be divided into two or more operable units, depending on the complexity of the problems associated with the site. The EPA and TCEQ have chosen to address the Site as a whole without division into operable units.

This is the first CERCLA response action to be conducted at the Site. This action will address hazardous substances that were deposited into sediment through the historic and permit-exceedance discharges of wastewater and storm water runoff from industrial facilities into Star Lake Canal and Jefferson Canal. Contaminated sediment will also be addressed in wetland areas that are connected to Star Lake Canal and Jefferson Canal. This includes the Former Star Lake, Gulf States Utility Canal, Molasses Bayou Waterway, and the Molasses Bayou Wetland areas. The action will also address the soil that was contaminated by sediment that was dredged from Jefferson Canal. Ground water will not be addressed by this action as it is currently being addressed by the TCEQ Groundwater Corrective Action Program.

The following Remedial Action Objectives (RAO) have been adopted to address the contaminated soil and sediment at the Site:

- Protect benthic invertebrates by reducing direct contact exposure with COCs in areas where sediment is designated as medium-high priority (Level 3) or high priority (Level 4) ecological risk using ERM-Q/PEL-Q method.

- Protect upper trophic level (UTL) receptors by reducing ingestion/direct contact with sediment concentrations in excess of remedial goals (RGs) in areas where sediment is designated as medium-high (3) or high priority (4) ecological risk using ERM-Q/PEL-Q method.

- Protect UTL receptors by reducing exposure to chemicals of potential ecological concern (COPECs) concentrations in excess of RGs in soil from the Jefferson Canal Spoil Pile.

The RAOs are described in more detail in Section 15 below.

12.0 SITE CHARACTERISTICS

The Site includes the two industrial canals from their origins to the confluence of Star Lake Canal with the Neches River and the adjacent wetlands. Star Lake Canal and Jefferson Canal were constructed to provide drainage and outfalls for effluent for the industrial facilities in the area. The straight-line distance along Star Lake Canal from its origin east of the intersection of Highway 136 and FM 366 to its confluence with the Neches River is approximately 16,500 feet. The straight-line distance along Jefferson Canal from its origin on the east side of Hogaboom Road south of FM 366 to its confluence with Star Lake Canal north of the Hurricane Protection Levee is approximately 4,000 feet. Star Lake Canal is up to 20 feet deep and 100 feet wide.

The Site physiography consists of a brackish water marsh area containing the tidal Molasses Bayou and lower Star Lake Canal and is located adjacent to the Neches River in the very flat and low-lying alluvial setting on the Gulf Coastal Plain. Elevations are less than approximately 5-feet as referenced to the National Geodetic Vertical Datum (NGVD). Portions of the marsh have been built up by dredged spoils from the Neches River or local tributaries. The Huntsman facility and upper Star Lake Canal are located on a Quaternary (Pleistocene) terrace elevated above the marsh and Neches River at elevations from approximately 5 to 15 feet NGVD. Natural surface drainage in the area has been heavily altered by the construction of the Star Lake and Jefferson canals that join together and flow into the Neches River through the marsh drained by a portion of the remaining Molasses Bayou. The Site has been divided into the following seven AOIs:

- Jefferson Canal
- Jefferson Canal Spoil Pile
- Former Star Lake
- Star Lake Canal
- Gulf States Utility Canal
- Molasses Bayou Waterway
- Molasses Bayou Wetland

Jefferson Canal

Access to the entire upstream portion of Jefferson Canal is limited to the public by a secure 8-foot-tall chain link fence within the Huntsman Chemical Plant. The canal is trapezoidal with a variable bottom width between 4-10 feet, side slopes at 2 horizontal to 1 vertical (2:1) side slopes, and is partially lined with concrete. The canal passes beneath Hogaboom Road and transitions to a grass-lined canal with a less defined shape. Jefferson Canal extends another 2,200 feet to a box culvert that goes beneath Farm to Market Road 366 (FM 366). The side slopes for this grassed section are approximately 12:1 and the bottom width is approximately 10-20 feet. At this location, Jefferson Canal is vegetated with trees on both sides. Several locations have wider cross sections and have side slopes of approximately 4:1. This canal is often partially inundated with water from storm runoff and a high water table. Water depth varies from 2.0-4.0 feet and is primarily influenced by surface runoff; tidally influenced in the lower reaches. The bottom is soft with 8-10 inches of fine sediment that is easily resuspended. Erosion and re-suspension of the canal sediment is

considered a secondary source of impact to the environment. A portion of the Jefferson Canal, located adjacent to the Hurricane Levee, is a depositional area; in this area approximately 3-feet of additional sediment has been deposited since the original construction of the levee. Also, other portions of the Jefferson Canal that are not cement lined may undergo erosion during large storm flows.

For the scope of the FS, Jefferson Canal is assumed to be a wetland. The soil classification for this section of the Jefferson Canal is identified as partially hydric. Wetland disturbance requires additional permitting and any altering of the wetland requires mitigation in the form of fees and additional wetland creation. The Jefferson Canal Upstream AOI includes the Huntsman facility storm water conveyance and the western portion of Jefferson Canal between Hogaboom Road and FM 366. This section of the canal is frequently dry or contains stagnant water resulting from rainfall/runoff; however, the canal will receive discharge from surrounding industries during severe rainfall events when secondary facility outfalls must be utilized. The Jefferson Canal Downstream AOI includes the northern portion of Jefferson Canal between FM 366 and its confluence with Star Lake Canal. The upstream and downstream portions of Jefferson Canal are separated by a section of the canal that runs parallel to FM 366 that is severely overgrown and allows no or very low flow of surface water except during severe rainfall/runoff events or secondary facility outfall usage. The downstream portion of the canal contains intermittent stagnant and low flowing water and portions of the canal are overgrown with vegetation. Based on test results, the Jefferson Canal AOI contains freshwater. The upstream portion of the Jefferson Canal AOI is outside the 500-year floodplain; whereas, the lower portion of the canal is inside the 100-year to 500-year floodplain.

Jefferson Canal Spoil Pile

This area contains dredged material that was deposited on the bank of Jefferson Canal. The spoil pile is located upstream from the Hurricane Protection Levee and downstream from FM 366. The southern limits of the spoil pile abut FM 366 Road, the Lower Neches Valley Authority Canal, and the Kansas City Southern Railroad. The western limit abuts to the overhead Entergy Power lines that extend south to north. Jefferson Canal extends from south to north on the eastern bank of the spoil pile. The area immediately east of Jefferson Canal is heavily vegetated with trees. The Jefferson Canal Spoil Pile was previously vegetated with trees, and during the Tier 2 RI those trees were removed to facilitate preparation of a topographic map and collection of soil samples. The spoil pile is partially composed of previously dredged material; therefore, it has a high lime content. The ground surface includes several low-lying "mounds" of the spoils that are a few feet in height and provide an uneven ground surface. Erosion of the Jefferson Canal Spoil Pile area is possible, even though the area is generally vegetated, and this erosion is considered a potential surface water and canal sediment impact. Rainfall runoff from the soil banks into Jefferson Canal was observed to result in minor erosion and sedimentation into Jefferson Canal. However, the erosion was extremely minor due to the heavy vegetative growth that exists along the spoil banks. The ground surface elevation is several feet above the groundwater table and drains from west to east into the Jefferson Canal. The dredged material formed mounds that are two to five feet high in most locations. This AOI has several underground pipelines crossing through it. A set-back or servitude will not be disturbed within 25 feet of the pipelines extending through the area for several alternatives below. The pipeline servitude accounts for approximately 24 percent of the area to be remediated within the Jefferson Canal Spoil Pile AOI. The Jefferson Canal Spoil Pile AOI is inside the 100-year to 500-year floodplain.

Former Star Lake

The Former Star Lake AOI includes the area of the former Star Lake southwest of Atlantic Road to the northwest and southeast of Star Lake Canal. The area consists of low-lying land that can become saturated

with water during severe rainfall/runoff events. The Former Star Lake area may be subject to erosion during large rainfall events. The Former Star Lake AOI is a marsh or wetland area with a silty bottom and wetland vegetation throughout. Erosion of the Former Star Lake area is possible, especially during large rainfall events, even though the area is generally vegetated. The bottom is generally 1 foot to 2 feet below tide and tidally inundated. The Former Star Lake AOI is inside the 100-year to 500-year floodplain. This AOI has several underground pipelines crossing through it. A set-back or servitude will not be disturbed within 25 feet of the pipelines extending through the area for several alternatives below. Based on current information, the pipeline servitude accounts for approximately 13 percent of the area to be remediated within the Former Star Lake AOI.

Star Lake Canal

The Star Lake Canal AOI includes the entire length of the canal from Orchard Road to its confluence with the Neches River. Star Lake Canal represents a continuous open water man-made channel with elevated banks that flows into the Neches River. The distance along Star Lake Canal from its origin east of the intersection of Highway 136 and FM 366 to its confluence with the Neches River is approximately 16,500 feet. The Star Lake Canal portion of the AOI for the FS commences at the point of intersection with Jefferson Canal and extends approximately 10,000 feet to the confluence with the Neches River. Immediately northeast of the intersection with the Atlantic Road is the Associated Marine Services, Inc., dock.

The channel is approximately 5 feet to 6 feet deep at the intersection with Jefferson Canal and about 20 feet wide with steep side slopes and a silty bottom. Erosion and re-suspension of the canal sediment is considered a secondary source of impact to the environment. Beginning at Atlantic Road, it is about 50 feet wide and gradually increases in width towards the Neches River to a width of about 150 feet to its confluence with the Neches River. The average depth is about 10 feet near the dock and 20 feet near the confluence with the Neches River.

The canal is tidally influenced and navigable. The upstream portion of Star Lake Canal generally contains freshwater and the lower portion generally contains saltwater. The upstream portion of the Star Lake Canal AOI is outside the 500-year floodplain, the middle portion of canal is inside the 100-year to 500-year floodplain and the lower portion of the canal is inside the 100-year floodplain. This AOI has several underground pipelines crossing through it. A set-back or servitude will not be disturbed within 25 feet of the pipelines extending through the area for several alternatives below. Based on current information, the pipeline servitude accounts for approximately 32 percent of the area to be remediated within the Star Lake Canal AOI.

Gulf States Utility Canal

The Gulf States Utility Canal extends parallel to the Star Lake Canal and is shallow, with side slopes at 4 horizontal to 1 vertical (4:1) or less. The canal was initially created to construct the overhead utility lines and is tidally inundated. The Gulf States Utility Canal AOI includes the entire length of the canal that runs parallel to Star Lake Canal. Gulf States Utility Canal represents a continuous open water man-made channel with elevated banks that connects to Star Lake Canal at discrete locations. The Gulf States Utility Canal is a heavily vegetated reach of slow moving water often overgrown with vegetation; it is generally a deposition environment but may experience erosion during large rainfall events. Based on test results, the Gulf States Utility Canal AOI generally contains saltwater. The Gulf States Utility Canal AOI is inside the 100-year floodplain.

Molasses Bayou Waterway

The Molasses Bayou Waterway AOI includes a narrow, shallow water channel that traverses the Molasses Bayou Wetland. The Molasses Bayou Waterway is a heavily vegetated meandering reach of slow moving water often overgrown with reeds and other vegetation; it is generally a depositional environment but may experience erosion during large rainfall events. Also, wakes from boat traffic in the Star Lake Canal near the entrance to Molasses Bayou may re-suspend the bottom sediment in Molasses Bayou as a result of the shallow depth there. The bayou is approximately 2 feet to 3 feet in depth with a bed consisting of 2 feet to 3 feet of fine-grained sediment and is tidally inundated. The cross section of the bayou varies from 3 feet to 30 feet in width. The waterway is influenced by tidal flow from the Neches River. The upstream portion of Molasses Bayou is a naturally occurring, open water channel surrounded by marsh and wetlands. The Molasses Bayou Downstream Waterway includes the portion of Molasses Bayou from near its split to its confluence with the Neches River. This portion of the bayou consists of a naturally occurring open water channel surrounded by marsh and wetlands with the exception of a portion that has silted in and no longer contains standing water from the point where it splits from the bayou. Historic aerial photographs indicate that this silted in portion was historically an open water channel. The Molasses Bayou Waterway AOI generally contains saltwater. The Molasses Bayou Waterway AOI is inside the 100-year floodplain.

During normal conditions not associated with a severe rainfall event, flow in the southern portion of Molasses Bayou was observed to be at extremely low velocities, estimated at less than 0.5 knots. This flow became nearly stagnant further northeast into Molasses Bayou and eventually nearly stagnant near the mid section of the bayou. Flow in the northern portion of Molasses Bayou was observed to be at low velocities during normal conditions, estimated at less than 0.5 knots.

Molasses Bayou Wetland

The Molasses Bayou Wetland AOI includes the marsh and wetland areas that surround the Molasses Bayou watercourse. The Molasses Bayou Wetland is a heavily vegetated marsh, with water approximately 1 foot to 2.5 feet in depth underlain by 2 feet to 3 feet of fine-grained sediment. The wetland has been silted in over time and is choked with vegetation. Erosion and re-suspension of canal sediment into surface water and deposition of the sediments in the surrounding wetland areas of the Site was the primary route of impact to the wetland sediment. The wetland area consists of low-lying land that can become saturated with water during severe rainfall or runoff events. The Molasses Bayou Wetland AOI generally contains saltwater. The Molasses Bayou Wetland AOI is inside the 100-year floodplain. This AOI has several underground pipelines crossing through it. A set-back or servitude will not be disturbed within 25 feet of the pipelines extending through the area for several alternatives below. The pipeline servitude accounts for approximately 1 percent of the area to be remediated within the Molasses Bayou Wetland AOI.

Flow in the open wetland was observed only during a period of inundation of the marsh due to heavy rainfall (5 inches of rainfall over two days). The flow was observed to be general sheet flow towards the Neches River with low velocities estimated at less than 0.5 knots. No flow was observed in the wetland areas when they were not inundated.

12.1 Surface Water Hydrology

Surface drainage from the Site flows through Jefferson Canal, Star Lake Canal, and Molasses Bayou to the Neches River. Water surface elevations in Jefferson Canal, Molasses Bayou and the lower portion of Star

Lake Canal are influenced by the stage of the Neches River and by tidal influences from the nearby Gulf of Mexico. Water elevations in the marsh and canal exhibit a maximum daily fluctuation of approximately 0.75 feet due to the tide. The water in the marsh is typically brackish, but may become characteristically fresh during flooding events from Star Lake Canal or the Neches River.

A dam on the Star Lake Canal approximately 2,800 feet upstream from the crossing of Atlantic Road and 1.8 miles from the mouth at the Neches River, holds water in a reservoir at an elevation of approximately 5 feet NAVD.

Flood stage events of the Neches River in the Site vicinity elevate the water surface to about 12 feet, approximately nine feet above the typical low gage height of approximately three feet at the Rainbow Bridge monitoring site. Flood stages that elevate the water surface four feet inundate the channels and marsh and create sheet flow across the entire marsh in the downstream direction. Surface water flow was observed in the field during the Tier 1 RI to evaluate direction and velocity in established natural channels and canals, and in the intervening marsh in order to evaluate the significance of tidal flow in the system. Tidal inflow and outflow in Star Lake Canal was visually observed during the field activity in October. Flow was observed to perceptibly move during tidal extremes, at an estimated velocity of one to two nautical miles per hour (knots). Flow was considerably accelerated subsequent to a rainfall event of over 5 inches on October 15 and 16. The high water in the Star Lake Canal due to the storm resulted in a backwater effect in the marsh of approximately 2.5 feet higher than normal, so that there was essentially no tidal flow associated with these water elevations.

During normal conditions not associated with a severe rainfall event, flow in the southern portion of Molasses Bayou was observed to be at extremely low velocities, estimated at less than 0.5 knots. This flow became nearly stagnant further northeast into Molasses Bayou and eventually nearly stagnant near the mid section of the bayou. Flow in the northern portion of Molasses Bayou was observed to be at low velocities during normal conditions, estimated at less than 0.5 knots.

Flow in the open marsh was observed only during the period of inundation of the marsh on October. The flow was observed to be general sheet flow towards the Neches River with low velocities estimated at less than 0.5 knots. No flow was observed in the marsh areas when they were not inundated.

Rainfall runoff from the soil banks along Jefferson Canal was observed to result in minor erosion and sedimentation into Jefferson Canal and subsequent discharge to Star Lake Canal. However, erosion was extremely minor due to the heavy vegetative growth that exists on the spoil banks.

12.2 Geology

The Site surface geology in the marsh consists of Quaternary (Holocene) natural and artificial (dredged) alluvial deposits from the Neches River. The marshland deposits typically contain fine-grained clay and organic alluvial sediments. The higher terrace surface, adjacent to the west, consists of the older, Pleistocene Beaumont Formation. The terrace deposits are typically composed of irregular beds of silts and clays with some fine sands. The coastal sediments in Texas are underlain by a very thick sequence of Pleistocene and older Cenozoic age coastal, marine, and deltaic sediments composed of widespread, thicker sand bodies separated by clay horizons that become thicker and deeper towards the Gulf.

The surface soils at the Site are predominantly organic clays and peats developed in the alluvium in the marsh area and clays that have developed in the deposits of the Beaumont Formation on the upland terrace,

according to the National Resource Conservation Service. The surface soil types of the marsh are the Bancker Series that developed in the present-day natural brackish marsh setting and the Ijam and Neel Series soils that develop in artificial dredge deposits. Bancker soil types are typically very poorly drained, and very slowly permeable and typically submergent. Neel soils are moderately well drained soils on higher landscape positions than the Ijam soils, which are poorly drained. Both are very slowly permeable. Bancker and Ijam soils may flood up to four feet or more during tropical storms. The surface soils of the older terrace deposits are the Labelle, League and Franeau Series that developed in relict backswamp deposits of antecedent rivers. These soil types are typically poorly to somewhat poorly drained, and slowly to very slowly permeable.

12.3 Hydrogeology

The surficial geology in the Site vicinity is composed of the primarily clayey member of the Beaumont Formation. Two more permeable horizons within the predominantly clayey lithology at the Site are termed the "A-Zone" and the "B-Zone" as were described from previous investigations at the Site. The "A-Zone" is typically five to ten feet thick and the top occurs within approximately 15 to 20 feet below the ground surface. The "B-Zone" is typically greater than ten feet thick and the top occurs approximately 60 to 70 feet below the ground surface. The horizons widespread and laterally continuous across the Site.

The A-Zone ground water is in communication with the surface water. The surface water elevations in the upstream portion of the Star Lake Canal are typically the highest elevations, followed by the upstream A-Zone ground water, then the downstream A-Zone ground water, and finally the canal surface water below the dam. Therefore, the typical hydraulic flow is from the surface water in the upstream Star Lake Canal reservoir to the groundwater and then from the groundwater back into the downstream portion of Star Lake Canal. Although the overall flow pattern is from the upstream canal to the ground water, there are a few instances during severe storm events when the A-Zone ground water upstream from the dam could discharge into the canal.

Ground water yield (slug test) data collected from monitor wells during the Huntsman Site-Wide Groundwater investigation indicated that ground water at the Site is potentially usable for drinking water purposes (Class 2). In addition, the potentiometric data collected during the Tier 1 RI near the Star Lake Canal dam indicates that ground water to surface water discharge may be possible. However, the potential groundwater to surface water interaction identified in both the Star Lake Canal and the Jefferson Canal has not resulted in the identification of any contaminants in surface water or sediment that pose unacceptable human health or ecological risks.

The risk assessment of the off-site groundwater plume is currently being evaluated under TCEQ's Corrective Action Program as part of the Huntsman Site-Wide Groundwater investigation. This ground water contamination is not a part of the Star Lake Canal Site.

12.4 Source of Contamination

Star Lake Canal and Jefferson Canal have been used by nearby industries for, initially, the un-permitted discharge of industrial effluents since the 1940s, which has resulted in the deposition of potentially hazardous constituents upon the sedimentary bottoms at the Site. The discharges are now regulated in accordance with a permit program. The source of the Site contamination is the historical discharge of chemicals by upstream industries into the Star Lake and Jefferson Canals. Subsequently, the contaminants were transported to other areas and media of the Site by mechanisms including deposition, sediment re-suspension, surface water transport, dredging, and erosion.

12.5 Nature and Extent of Soil, Sediment, and Surface Water Contamination

12.5.1 Investigation

Data for sediment, surface water, soil, and tissue were collected during the Tier 1 and Tier 2 RI. The locations of the Tier 1 Remedial Investigation samples is shown on Figure 14 and the Tier 2 sediment and surface water sample locations is shown on Figure 15. Figure 16 shows the soil sample locations in the Jefferson Canal Spoil Pile AOI for both Tier 1 and Tier 2.

A total of 258 sediment samples were collected from the Site at 118 locations in Star Lake Canal, Former Star Lake, Gulf States Utility Canal, Molasses Bayou Upstream Watercourse, and Molasses Bayou Downstream Watercourse, Molasses Bayou Wetland, Jefferson Canal Upstream, and Jefferson Canal Downstream AOIs. Sediment samples were collected from the surface (0 to 6-inch), from 6 to 12-inches, and from 12 to 18-inches. Surface (0 to 6-inch) sediment samples represent the top six inches of sediment and were collected in areas that may have accumulated re-suspended sediment and/or erosion materials and represent a less dynamic erosion/sedimentation system. The 6 to 12-inch and the 12 to 18-inch sediment samples represent the middle and bottom six inches of sediment, respectively. The 6 to 12-inch and 12 to 18-inch sediment samples were obtained where significant inflows and a more dynamic erosion/sedimentation system have the potential to bring in large volumes of water possibly laden with erosional material and where historical surface sediment sample collection revealed detectable concentrations of constituents. In addition, 12 to 18-inch and 18 to 24-inch sediment samples were collected to provide vertical delineation of impacted sediment at several locations across the Site. Additional details on the sediment sampling locations and depths are provided in the *Final Feasibility Study Report*. The analytical laboratory results from sediment samples are summarized on Table 2, attached, and shown in the *Final Tier 2 Remedial Investigation Report, Tables 6-2A through 6-2H.*

A total of 65 surface water samples were collected from the Site at 65 sample locations in Star Lake Canal, Gulf States Utility Canal, Molasses Bayou Upstream Watercourse, Molasses Bayou Downstream Watercourse, Molasses Bayou Wetland, Jefferson Canal Upstream, and Jefferson Canal Downstream AOIs. The analytical laboratory results from surface water samples are shown in the *Final Tier 2 Remedial Investigation Report, Tables 6-1A through 6-1G.*

A total of 108 soil samples were collected from the Site at 29 locations in the Jefferson Canal Spoil Pile AOI on the banks of the downstream portion of Jefferson Canal. The soil sample locations include eight borings, JCSP-1 through JCSP-8, that were installed in the identified spoil material to a depth of approximately 60 inches (five feet) below the typical ground surface. Samples were collected from each of the spoil material borings from a location within the spoil material, at depth intervals of 0 to 6 inches, 6 to 12 inches, 12 to 24 inches, and at the total depth of the boring (54 to 60 inches) bgs. A total of 17 soil borings (JCSP-9 through JCSP-25) were installed in areas around the perimeter of the identified spoil material to a depth of approximately 60 inches (5 feet) bgs for delineation of the horizontal extent of potential soil impact from the spoil material. Samples were collected from each of the perimeter borings at depth intervals of 0 to 6 inches, 6 to 12 inches, 12 to 24 inches, and 54 to 60 inches below ground surface. Additional details on the soil sampling locations and depths are provided in the *Final Feasibility Study Report*. The analytical laboratory results from the soil samples are shown in the *Final Tier 2 Remedial Investigation* Report, Table 6-3.

A total of 110 fish tissue composite samples, including 40 fish tissue samples for the human health risk assessment (HHRA) and 70 tissue samples for the baseline ecological risk assessment (BERA), were collected

from locations across the Site that were accessible by human or watercraft and that represented reasonable habitats for the target species. The biological tissue sample collection activities were completed from April through October 2009. Fish tissue samples collected for use in the HHRA were collected from the open-channel, fishable portions of Star Lake Canal and Molasses Bayou. There were not fish or shellfish available for collection in the accessible portions of Gulf States Utility Canal or Jefferson Canal that met TCEQ's minimum size requirements.

Tissue samples collected for the HHRA consisted of fish species that represent the two major ecological environments that fish inhabit in the bayou setting, specifically fish and shellfish that primarily occupy bottom feeding locations and those that typically inhabit and feed in the open water column. Pelagic or predatory fish species samples were collected primarily from Star Lake Canal. Approximately half of the pelagic fish tissue samples consisted of spotted gar and were collected from Star Lake Canal just downstream of the dam. The remaining portion of the pelagic fish tissue samples consisted of black drum, red drum, and spotted sea trout and were collected from Star Lake Canal at its confluence with the Neches River. Bottom feeding fish samples were collected primarily from Star Lake Canal and portions of Molasses Bayou at its confluence with Star Lake Canal. The bottom feeding fish samples consisted of hardhead catfish and southern flounder. Shellfish samples, consisting of blue crab, were collected primarily from Star Lake Canal and portions of Molasses Bayou.

Tissue samples collected for use in the BERA were from areas throughout the Site that represented likely habitats for the receptors of concern (ROC) and their prey. Fish and invertebrate tissue samples were collected from open water habitat and fringe marsh habitat where both fish and benthic/epibenthic invertebrates were expected to physically reside. Ecological fish tissue samples were collected primarily from Star Lake Canal, Gulf States Utility Canal, and Molasses Bayou. Ecological fish were collected in two size ranges (1 to 6 inches) and (6 to 12 inches) to assess potential risk for various feeding guilds. Ecological fish tissue samples consisted of composites of croaker, fathead minnow, gulf menhaden, and striped mullet. Fish were collected by both cast net and gill net. Ecological shellfish samples, consisting of whole body blue crab, were collected primarily from Star Lake Canal and portions of Molasses Bayou at its confluence with Star Lake Canal. Additional tissue samples collected include terrestrial and aquatic emergent insects, earthworms, vegetation samples, and bullfrogs. Attempts were made to collect mussel and other mollusk samples, but none were available at the Site.

The analytical laboratory results from the biological tissue samples are shown in the *Final Tier 2 Remedial Investigation Report, Tables 6-4A through 6-4D.*

Geotechnical and general chemistry data were also collected from sediment sample locations throughout the Site. Sediment samples were analyzed for total organic carbon, particle size, and moisture content. The geotechnical and general chemistry data are shown in the *Final Tier 1 Remedial Investigation Report, Tables 5-3A through 5-3D*

12.5.2 Results Discussion

The Star Lake Canal and the Jefferson Canal are the primary source areas for contamination in the rest of the Site. The surface water and sediment sample results from Star Lake Canal and Jefferson Canal are discussed below. Figures 18, 19, 20, and 21 are Site maps showing certain sample results and their locations. Additional sampling results are shown and discussed in the *Final Tier 1 Remedial Investigation Report* and the *Final Tier 2 Remedial Investigation Report.*

Surface Water: Star Lake Canal

- Volatile organic compound (VOC) constituents in Star Lake Canal surface water samples that were detected in more than one sample consisted of methyl tert butyl ether (MTBE), xylene, styrene, bromoform, 4-methyl-2-pentanone, and benzene. MTBE, styrene, and xylene were the most frequently detected. Detected concentrations of all constituents were in general less than approximately 0.0005 mg/L.
- Semi volatile organic compounds (SVOC) constituents in Star Lake Canal surface water samples that were detected in more than one sample consisted of di-n-butylphthalate in samples SLC-1, SLC-2, SLC-4, and SLC-7 with a maximum concentration of 0.00037 mg/L at location SLC-7.
- PAH constituents in Star Lake Canal surface water samples that were detected in more than one sample consisted of acenaphthylene, anthracene, chrysene, fluoranthene, fluorene, phenanthrene, and pyrene. Detected concentrations of all constituents were in general less than approximately 0.0001 mg/L.
- Metal constituents were detected in Star Lake Canal surface water samples on a frequent basis. Several metals identified as contributing to ecological risk, including antimony, cadmium, copper, mercury, and zinc, were either non-detect or detected at levels less than 1 mg/L in surface water.
- No total petroleum hydrocarbons (TPH), PCBs, or pesticides were detected in more than one sample in Star Lake Canal surface water samples.

Surface Water: Jefferson Canal

- VOC constituents in Jefferson Canal surface water samples that were detected in more than one sample consisted of 1,1-dichloroethene, 1,2-dichloroethane, 1,2-dichloropropane, benzene, carbon tetrachloride, chlorobenzene, chloroform, cis-1,2-dichloroethene, trans-1,2-dichloroethene, and trichloroethene. Detected concentrations of all VOC constituents were in general less than approximately 0.05 mg/L with the exception of 1,2-dichloropropane detected at elevated concentrations in JC-5 through JC-7, with a maximum concentration of 1.2 mg/L in JC-7, and carbon tetrachloride in JC-7with a maximum concentration of 0.16 mg/L.
- SVOC constituents in Jefferson Canal surface water samples that were detected in more than one sample consisted of 2,4,6-trichlorophenol, 2,4-dichlorophenol, 2-chlorophenol, benzaldehyde, bis(2-chloroethyl)ether, bis(2-chloroisopropyl)ether, and pentachlorophenol. Detected concentrations of all SVOC constituents were in general less than approximately 0.01 mg/L with the exception of bis(2-chloroethyl)ether, bis(2-chloroisopropyl)ether, and pentachlorophenol, which were detected at maximum concentrations of 0.026 mg/L, 0.77 mg/L and 0.1 mg/L, respectively at sample location JC-7.
- All PAH constituents analyzed in Jefferson Canal surface water samples were detected in more than one sample. These constituents consisted of 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, ideno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene. Selected PAH detections in Jefferson Canal surface water are shown in the attached figures.
- Metal constituents were detected in Jefferson Canal surface water samples on a frequent basis. Several metals identified as contributing to ecological risk, including antimony, cadmium, copper, mercury, and zinc, were either non-detect or detected at levels less than 1 mg/L in surface water.
- No TPH, PCBs, or pesticides were detected in more than one sample in Jefferson Canal surface water samples.

The Star Lake Canal and the Jefferson Canal are the primary source areas for contamination in the rest of the Site. Additional surface water sampling results are discussed in the *Final Tier 1 Remedial Investigation Report* and the *Final Tier 2 Remedial Investigation Report.*

Sediment: Star Lake Canal

- VOC constituents in Star Lake Canal sediment samples that were detected in more than one sample consisted of 1,2-dichlorobenzene, 1,2-dichloroethane, 2-butanone, acetone, carbon disulfide, chlorobenzene, cyclohexane, ethylbenzene, isopropyl benzene, methyl acetate, methyl cyclohexane, MTBE, methylene chloride, styrene, trifluorotrichloroethane, xylene, 2-Butanone, carbon disulfide, isopropyl benzene, and MTBE were the most frequently detected. Detected concentrations of all constituents were in general less than approximately 0.2 mg/kg. The VOC samples showed a variety of concentration trends with increasing depth at a given sample location, however, one trend that occurred more frequently showed the following: lowest VOC concentration at the surface, highest concentration at the 6 to 12-inch depth, then a reduced concentration at 12 to 18-inches.
- SVOC constituents in Star Lake Canal sediment samples that were detected in more than one sample consisted of acetophenone, benzaldehyde, biphenyl, carbazole, dibenzofuran, di-n-butylphthalate, and n-nitrosodiphenylamine. Detected concentrations of all constituents were in general less than approximately 0.3 mg/kg. There were no apparent SVOC concentration trends with increasing depth.
- TPH (C6-C12), (>C12-C28), (>C28-C35), and (C6-C35) concentrations were detected in more than one sample: Star Lake Canal surface sediment samples SLC-6, SLC-7, and SLC-9, in mid-depth sediment sample SLC-6, and in refusal depth sediment samples SLC-4 and SLC-5. TPH (C6-C35) had a maximum concentration of 1,700 mg/kg at mid-depth sediment sample SLC-6. The TPH concentrations generally decreased with increasing depth, however, there are some locations with no concentration trend with depth and some locations with increasing TPH concentrations with depth.
- All PAH constituents were detected in more than one sample in all Star Lake Canal sediment samples with the exception of mid- and refusal depth sample SLC-9. Detected concentrations of all constituents were in general less than approximately 1.0 mg/kg. The PAH concentrations generally decreased with increasing depth, however, there are some locations with no clear concentration trend with depth and some locations with increasing PAH concentrations with depth
- PCB constituents that were detected in more than one sample in Star Lake Canal consisted of PCB-1242, PCB-1248, PCB-1254, and PCB-1260 with a maximum concentration of 3.2 mg/kg of PCB-1242 in mid-depth sediment sample SLC-6. The PCB concentrations generally decreased with increasing depth, however, there are some locations with no clear concentration trend with depth and some locations with increasing PCB concentrations with depth.
- Metal constituents were detected in Star Lake Canal sediment samples on a frequent basis. The maximum concentrations of several metals contributing to ecological risk are: cadmium – 1.25 mg/kg; copper - 635 mg/kg; mercury – 3.4 mg/kg; and zinc – 2.18 mg/kg.
- No pesticides were detected in more than one sample in Star Lake Canal sediment samples.

Sediment: Jefferson Canal

- VOC constituents in Jefferson Canal sediment samples that were detected in more than one sample consisted of 1,1-dichloroethene, 1,2-dichlorobenzene, 1,2-dichloropropane, 1,3-dichlorobenzene, 1,4-dichlorobenzene, acetone, benzene, carbon disulfide, carbon tetrachloride, chlorobenzene, chloroform, ethylbenzene, isopropylbenzene, methyl cyclohexane, methylene chloride, styrene, tetrachloroethene, trifluorotrichloroethane, and xylene. Detected concentrations of all VOC constituents were in general less than approximately 0.5 mg/kg with the exception of carbon tetrachloride, chloroform,

ethylbenzene, and xylene in surface sediment sample JC-7 with concentrations of 1.8 mg/kg, 4.2 mg/kg, 1.2 mg/kg, 5.2 mg/kg, and 1.7 mg/kg, respectively. There were no clear VOC concentration trends with increasing depth.

- SVOC constituents in Jefferson Canal sediment samples that were detected in more than one sample consisted of 2,4,6-trichlorophenol, 2,4-dichlorophenol, 2-chloronaphthalene, 2-chlorophenol, acetophenone, benzaldehyde, biphenyl, bis(2-ethylhexyl)phthalate, carbazole, hexachlorobutadiene, n-nitrosodiphenylamine, and pentachlorophenol. Detected concentrations of all SVOC constituents were in general less than approximately 1.0 mg/kg with the exception of biphenyl and pentachlorophenol which were detected at a maximum concentration of 26 mg/kg at JC-5 and 140 mg/kg at JC-7, respectively. There was no clear SVOC concentration trend with increasing depth; however, the few samples containing the higher levels of SVOC had increasing SVOC concentration with increasing depth over the sampled depths (0 to 18-inches).
- TPH (C6-C12), (>C12-C28), (>C28-C35), and (C6-C35) concentrations were detected in multiple Jefferson Canal sediment samples with the exception of JC-3. TPH (C6-C35) had a maximum concentration of 1,700 mg/kg at refusal-depth sediment sample JC-7. There was no clear TPH concentration trend with increasing depth; however, the highest levels of TPH were either at the 6 to12-inch depth or the 12 to 18-inch depth.
- All PAH constituents analyzed in Jefferson Canal sediment samples were detected in more than one sample. Benzo(a)pyrene was detected with a maximum concentration of 6.0 mg/kg in refusal sediment sample JC-5. All PAH constituents were detected in surface sediment sample JC-2 and in refusal depth sediment sample JC-5.
- Metal constituents were detected in Jefferson Canal sediment samples on a frequent basis. The maximum concentrations of several metals contributing to ecological risk are: antimony – 4.05 mg/kg; cadmium – 4.72 mg/kg; copper – 1,340 mg/kg; mercury – 1.19 mg/kg; and zinc – 444 mg/kg.
- Pesticides in Jefferson Canal sediment samples that were detected in more than one sample consisted of 4,4'-DDT, aldrin, alpha-chlordane, delta-BHC, dieldrin, endrin, endrin aldehyde, endrin ketone, lindane, heptachlor, heptachlor epoxide, alpha-BHC, and endosulfan I. Detected concentrations of all pesticide constituents were in general less than approximately 0.5 mg/kg.
- PCB constituents that were detected in more than one sediment sample in Jefferson Canal consisted of PCB-1248 and PCB-1254 with a maximum concentration of 1.6 mg/kg of PCB-1248 in refusal depth sediment sample JC-5.

The Star Lake Canal and the Jefferson Canal are the primary source areas for contamination in the rest of the Site. Additional sediment sampling results are discussed in the *Final Tier 1 Remedial Investigation Report* and the *Final Tier 2 Remedial Investigation Report*.

12.6 Fate and Transport

Constituent fate and transport summarizes the physical and chemical characteristics of the Site including constituent properties and potential routes and mechanisms for migration of constituents through each environmental medium. Historical discharges from surrounding industry are the primary source of impacts at the Site. Constituents were discharged to surface water and sediments in both Jefferson Canal and Star Lake Canal and subsequently to other areas and environmental media within the Site by various transport mechanisms including sediment re-suspension, surface water transport, dredging sediment, and erosion of sediment spoil piles. During periods of high tide or storm events, re-suspended sediment and eroded materials from the canals may have been re-deposited in adjacent wetland areas, such as the Molasses Bayou sediment being transported to the Molasses Bayou wetland.

PAHs generally have low water solubility and may increasingly adsorb to soil, sediment, or suspended solid particles within water with increasing organic carbon content. However, the lower molecular weight PAHs are more biodegradable, volatile, and water-soluble than the heavier PAH compounds. Naphthalene has the lowest molecular weight of all PAHs and is the most soluble. Adsorption is also directly dependent on particle size. Smaller particles with higher surface area to volume ratios are more efficient at adsorbing PAHs. PAH compounds are more mobile in systems with small amounts of organic carbon. Adsorption to soil particles is the primary process responsible for the removal of PAHs from aqueous systems. The Henry's Law constant (KH) ranges from 10^{-4} to 10^{-8} atmospheres per cubic meter per mole (atm-m^3/mol) for individual PAHs. The soil organic carbon water partition coefficient K_{oc} values for the high molecular weight PAHs are in the range of 105 to 106, which indicates a strong tendency to adsorb to organic carbon present in soil and sediment. The high adsorption potential of PAHs to soil and sediment explains the frequency with which PAHs were detected in soil and sediment samples at the Site. The PAH concentrations in the soil and sediment at the Site, their tendency to sorb onto particles, and their generally reduced concentration with depth indicate that migration to groundwater is not likely.

PCBs are a class of organic compounds with 1 to 10 chlorine atoms attached to biphenyl, which is a molecule composed of two benzene rings. PCBs are highly resistant to chemical or biological transformation. They exhibit a high degree of persistence in the environment and biomagnification in aquatic and terrestrial food chains and are thus treated as a special class of compounds. PCBs are insoluble in water and will partition from the water column and adsorb strongly to sediments and suspended matter. The solubility of PCBs decreases with increases in chlorination. The organic carbon partition coefficient is higher for the higher chlorinated isomers, which indicates they will sorb more strongly. PCBs volatilize from water. PCBs of the higher chlorinated biphenyl groups (e.g., higher than the tetrachlorinated biphenyls) do not significantly biodegrade in soils, especially those with high organic carbon content. In sediment, there is a potential for anaerobic biodegradation, which is determined by congener reactivity. Biomagnification via impacted food is the principle route of uptake for low water-soluble compounds like PCBs. The major source to plant vegetation is through contact with volatilized PCBs in the air. The PCB concentrations in the soil and sediment at the Site, their tendency to sorb onto particles, and their generally reduced concentration with depth indicate that migration to groundwater is not likely.

Arsenic is a naturally occurring element that is widely distributed in the Earth's crust. Arsenic is classified chemically as a metalloid, having both properties of a metal and a non-metal. It has oxidation states of +1, +2, +3, +5, and -3. Elemental arsenic is a steel grey solid material; however, arsenic is usually found in the environment combined with other elements such as oxygen, chlorine, and sulfur. Arsenic combined with carbon and hydrogen is referred to as organic arsenic. Until December 31, 2003, inorganic arsenic compounds were primarily used to preserve wood. Copper chromated arsenic (CCA) was used to make "pressure-treated" lumber. CCA is no longer used in the U.S. for residential purposes. In the past, inorganic arsenic compounds were predominantly used as pesticides, primarily on cotton fields and in orchards. Inorganic arsenic compounds are no longer used in agriculture. However, some organic arsenic compounds are still used in pesticides. Arsenic cannot be destroyed in the environment. It can only change its form or become attached to or separated from particles. Arsenic may be transported by wind or in runoff or may leach into subsurface soil. Arsenic is largely immobile in soil; therefore, it tends to concentrate and remain in the upper soil layers and not migrate to groundwater. Transport and partitioning of arsenic in water depends upon the chemical form. Soluble forms move with the water and may be carried long distances. Arsenic may be adsorbed from water onto sediment or soil particles.

Cadmium is a natural metal in the earth's crust and is usually found as a mineral combined with other elements such as oxygen (cadmium oxide), chlorine (cadmium chloride), or sulfur (cadmium sulfate,

cadmium sulfide). In the environment, cadmium enters soil, water, and air from mining, industry, and burning coal and household wastes. Cadmium can change forms in the environment, but does not break down and airborne particles can enter the ground and water. In the ground cadmium binds strongly to soil particles and some forms can dissolve. Fish, plants, and animals can take up cadmium from their environments.

Copper is released into the environment by mining, farming, and manufacturing operations and through wastewater releases into lakes and rivers. Natural sources of copper releases include windblown dusts, decaying vegetation, forest fires, and volcanoes. Once in the environment, copper usually attaches to particles made of organic matter, clay, soil, or sand, and it does not breakdown.

Mercury is a naturally occurring element and also may be released by industrial activities such as mining and burning of fossil fuels. Inorganic mercury compounds (mercury salts) occur when the element combines with others such as chlorine, sulfur, or oxygen. When mercury combines with carbon it forms compounds called organomercurials, the most common of which is methylmercury. Methylmercury is produced primarily by microorganisms (bacteria and fungi) in the environment, rather than by human activity. Concern surrounding methylmercury is due to its tendency to bioaccumulate in various edible freshwater and saltwater fish and marine mammals.

Vanadium is the 22nd most abundant element in the earth's crust and is widely distributed. It occurs in nature as a white-to-gray metal, and is often found in the form of crystals. Vanadium usually combines with other elements such as oxygen, sodium, sulfur, or chloride. It has oxidation states of +2, +3, +4, and +5. Because of its high melting point, it is referred to as a refractory metal. Most of the vanadium used in the U.S. is used to make steel. Vanadium cannot be destroyed in the environment. It can only change its form or become attached to or separated from particles. Vanadium particles in the air settle to the ground or are washed out of the air by rain. Smaller particles, such as those emitted from oil-fueled power plants, may stay in the air for longer periods of time and are more likely to be transported farther away from the site of release. The transport and partitioning of vanadium in water and soil is influenced by many factors including acidity of the water or soil and the presence of particulates. Vanadium can either be dissolved in water as dissolved ions or may become adsorbed to particulate matter.

Zinc enters the air, water, and soil as a result of both natural processes and human activities. Most of the zinc in lakes or rivers settles on the bottom. However, a small amount may remain either dissolved in water or as fine suspended particles. The level of dissolved zinc in water may increase as the acidity of water increases. Most of the zinc in soil is bound to the soil and does not dissolve in water. Zinc in aerobic waters is partitioned into sediments through sorption onto hydrous iron and manganese oxides, clay minerals, and organic material. Zinc sorbs strongly onto soil particulates.

In general, the tendency of many of the constituents to sorb onto particles and their generally reduced concentration with depth indicate that migration to groundwater is not likely. However, the groundwater contamination is being addressed under the TCEQ Site-Wide Groundwater Corrective Action Monitoring Program.

13.0 CURRENT AND POTENTIAL FUTURE LAND AND WATER USES

13.1 Demography

According to the 2000 U.S. Census figures, Port Neches has a population of 13,601. Jefferson County's population is 249,640, which contains 57.2 percent Anglo, 33.7 percent black, 10.5 percent Hispanic or

Latino, and 9.1 percent other. The per capita income as of 1999 for Jefferson County was $17,571. The average household size in Jefferson County is 2.55, which is slightly less than the Texas average of 2.74.

13.2 Current and Potential Future Uses

Industrial operations have occurred in areas surrounding the Site since the early 1940s. Initial construction of industrial facilities occurred under the direction of the United States government during World War II, and subsequent industrial operations have continued through the present. In addition, residential development is present adjacent to the south side of the Molasses Wetland area.

Public supply wells do not exist within a three-mile radius of the Site. There are no known drinking water wells down gradient of the Huntsman property that reaches to the edge of the watershed along the Neches River. Based on water well survey information obtained from the Texas Water Development Board (TWDB) Groundwater Database (GWDB), there are two water wells registered within a 1-mile radius of the Site: one is classified as unused, and the other is a stock watering well. The ground water at the Site is, however, classified as Class 2, potentially usable for drinking water use. Drinking water in the area is supplied by the Lower Neches Valley Authority (LNVA) whose surface water intake points are north and upstream of the Site, in the City of Beaumont, Texas.

The current land and water use conditions are expected to continue in the future and to be unchanged as a result of the remedial action.

14.0 SUMMARY OF SITE RISKS

Under the NCP, 40 CFR § 300.430, the role of the baseline risk assessment is to address the risk associated with a Site in the absence of any remedial action or control, including institutional controls (ICs). The baseline assessment is essentially an evaluation of the no-action alternative. (See 55 FR 8666 and 8710, March 8, 1990). The baseline risk assessment also provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. This section of the ROD summarizes the results of the HHRA and the BERA for the Site.

As part of the RI/FS, a HHRA and a BERA were conducted to evaluate the current and future effects of contaminants found in soil, sediment, surface water and biota on human and ecological receptors. Both the HHRA and the BERA risk assessments were conducted in a two-tier process. The first tier served as a screening level and to guide a more site specific and comprehensive risk assessment in the second tier. The results for the first tier are presented in the Tier One Remedial Investigation Report and the results of the second tier are presented in the Final Tier Two Remedial Investigation Report. Following the completion of the RI an Alignment Document and a Sensitivity Analysis were completed to resolve issues and facilitate the completion of the FS. The results of the sensitivity analysis are presented in the Final FS Report.

During the Remedial Investigation seven AOIs were established. This was done because of the size of the site, the different habitat types, to simplify the sampling design, and to simplify the decision making process. For some UTLs that have a large home range, the data from the entire site was used to calculate risk. For receptors with a limited range, the risk was calculated on an AOI basis or using data from individual sample locations. After completion of the RI the AOIs were divided again to allow for a more focused assessment of risks to benthic invertebrates. Individual areas were identified where the risk to benthic invertebrates was determined to be medium-high or high. Because of this, areas in the FS are described using Thiessen polygons or AOIs. Figure 3 shows the sub-areas (Thiessen polygons) and AOIs.

14.1 Conceptual Site Model

This section identifies and discusses the constituent fate and transport mechanisms at the Site and the various potential human and ecological exposure pathways to the constituents. A conceptual site model (CSM) of constituent fate and transport to ecological receptors is presented on Figure 12. A CSM of constituent fate and transport to human receptors is presented on Figure 13. As shown on the figures, historical discharges from surrounding industry are the primary source of potential impact at the Site. Constituents were discharged to surface water and sediments in both Jefferson Canal and Star Lake Canal and subsequently to other areas and environmental media within the Site by various transport mechanisms including sediment re-suspension, surface water transport, dredging sediment, and erosion of sediment spoil piles. The different exposure pathways for general groups of potential receptors chosen for this Site are shown on the CSM figures. Potential ecological receptors include shorebirds, waterfowl, songbirds, mammals, reptiles and amphibians, fish, and terrestrial and aquatic invertebrates. Potential human receptors that may use portions of the Site include recreational users, industrial workers, fishermen/shell fishers, and trespassers.

14.2 Human Health Risks

The human health risk assessment focused on the potential for human health effects from exposure to contaminants at the site. Jefferson Canal Spoil Pile soil results were compared to TCEQ Commercial/Industrial Protective Concentration Levels for incidental ingestion, dermal or skin contact, and the inhalation of chemicals emitted from the soil. Surface water and sediment sample results were compared to the TCEQ Contact Recreation Water Protective Concentration Levels for the incidental ingestion of surface water and dermal or skin contact with surface water. In addition, surface water sample results were compared to human health surface water TCEQ Risk-Based Exposure Limits (RBELs) for non-drinking water body for the consumption of fish. As part of the risk assessment, the exposure to harmful chemicals that a person could have while engaged in various activities or scenarios was calculated, and the risk from this exposure was evaluated. The scenarios and activities evaluated include recreational swimming, wading, recreational fishing, trespass wading, trespass fishing, industrial worker, and outside worker. The potential human health risk from groundwater was not considered in the human health risk assessment because Huntsman is currently conducting a groundwater corrective action monitoring program at the adjacent Huntsman PNPP facility under TCEQ's Corrective Action Program in accordance with the Resource Conservation and Recovery Act (RCRA).

The human health risk assessment indicated that the potential human health risk from the site is low and does not pose an unacceptable risk for human receptors that may use the site. The calculated non-carcinogen hazard indexes (HI) for all receptors were below the level of 1 which indicates that non-cancer health effects are unlikely to occur. The risk of cancer from exposure to a chemical is described in terms of the probability that an individual may develop cancer because of a lifetime of exposure (i.e., 70 years). In general, the EPA considers lifetime excess cancer risks that are below 1 chance in 1,000,000 (1×10^{-6} or 1E-06) to be so small as to be negligible, and risks above 1 chance in 10,000 (1×10^{-4} or 1E-04) to be sufficiently large that remediation is generally warranted. Excess cancer risks that range between 1E-06 and 1E-04 are generally considered to be acceptable, but this is evaluated on a case-by-case basis and the EPA may determine that risks lower than 1E-04 are not sufficiently protective and warrant remedial action. The calculated cancer risk for all receptor scenarios at the Star Lake Canal Site is less than 1 chance in 10,000 or (1×10^{-4} or 1E-04). The receptor scenarios included in this assessment include recreational fishing, recreational swimming/wading, trespass wading, industrial (maintenance) worker, and industrial (outdoor) worker. As the site is primarily an

industrial site with limited access for fishing by the general public it was determined that the cancer risk is acceptable. Therefore, no RAOs were needed or developed for the protection of human health.

14.3 Ecological Risks

The first tier of the ecological risk assessment is called a screening level ecological risk assessment (SLERA). The results of the SLERA are presented in the Tier One RI Report. The SLERA was used to produce a list of contaminants of potential ecological concern (COPECs) and to define the extent of the contamination. The results of the SLERA showed that at least one screening level benchmark was exceeded at every sediment sampling location. All of the soil samples collected at the site came from the Jefferson Canal Spoil Pile AOI and the results indicated that soil from this AOI also exceeded the ecological screening benchmarks. At the conclusion of the SLERA, 26 volatile organic compounds (VOCs), 32 semi-volatile organic compounds (SVOCs), 20 pesticides, 26 metals, PAHs, and PCBs were retained as COPECs in soil or sediment. The identified COPECs were carried forward for a more thorough analysis in the BERA.

The BERA focused on the potential for ecological receptors to be harmed by exposure to contaminants in environmental media such as soil, surface water, and sediment. The BERA also evaluated the risk of ingesting contaminants that accumulated in plants and animals that are part of the food chain. The ecological receptors identified as assessment endpoints included avian, reptilian, terrestrial mammal, terrestrial invertebrate, terrestrial plant, fish, and benthic invertebrate populations. The receptors of concern include species observed during field observations as well as threatened and endangered species identified based on a habitat suitability approach for the area. The receptors of concern for the BERA, as identified in the *Final Tier 2 Remedial Investigation Report*, include the Green Heron, White-Faced Ibis, Belted Kingfisher, Marsh Wren, Mallard, Muskrat, Raccoon, Brown Pelican, American Robin, Short-Tailed Shrew, Spotted Sandpiper, Painted Turtle, Wood Stork, Reddish Egret, and Bullfrog.

Benthic invertebrates are small aquatic insects and animals that live at the bottom of water bodies. Benthic invertebrates are frequently evaluated in ecological risk assessments because they are an important component of the aquatic food chain. In addition to this the small size, limited mobility and prolonged contact that benthic invertebrates have with water and sediment make them a good indicator of the risk from hazardous chemicals. The potential risk to benthic invertebrates was evaluated using a weight of evidence approach to reduce the uncertainty associated with making a decision based on a single line of evidence. Risk to benthic invertebrates was evaluated at each sample location because of the small home range and lack of mobility of these receptors. The lines of evidence used to evaluate the risk to benthic invertebrates are described below.

- The effect range medium quotient (ERM-Q) and probable effect level quotient (PEL-Q) method uses sediment quality guidelines developed by the National Oceanic and Atmospheric Administration (NOAA). The ERM and PEL sediment quality guidelines are representative of the concentration at which harmful effects are likely. This method also uses studies done by Long and McDonald (1998) where the concentration of each constituent in a sample is divided by its respective ERM or PEL value resulting in an ERM-Q or PEL-Q value. The mean ERM-Q or PEL-Q value is then used to classify the sediment into four categories based on the probability of toxicity. Figure 4 shows the areas that are designated as a medium high risk (greater than 50% chance of amphipod toxicity) or high risk (greater than 74% chance of toxicity). The Long and McDonald (1998) studies have shown a high correlation between the predicted probability of toxicity and the results obtained by toxicity testing. The results of this analysis are presented on Table 9-2 of the *Final Tier 2 Remedial Investigation Report*.

- A comparison of sediment and water concentrations to the TCEQ first effect, midpoint, and second effect benchmarks was presented in the *Final Tier 2 Remedial Investigation Report* (Table 9-3). If a COPEC concentration exceeded the midpoint value then further action is indicated by this line of evidence.

- A comparison of total PAH concentrations to total PAH benchmark values was the third line of evidence used. This method used the TCEQ (2006) approach of totaling the concentrations of thirteen individual PAHs to calculate a total PAH value. This value was compared to first effect, midpoint, and second effect benchmarks. A Hazard Quotient (HQ) >1 for total PAH using the midpoint benchmark was used to identify areas with potential risk to benthic invertebrates from PAH toxicity.

- The fourth method used was the ratio of the simultaneously extractable metals (SEM) and the acid volatile sulfides (AVS). If the ratio of the SEM divided by the AVS in sediment is less than 1, then the pore water toxicity of some metals is low. This method of analyzing metal bioavailability only applies to six metals including copper, lead, cadmium, nickel, zinc, and silver. Table 9-5 of *the Final Tier 2 Remedial Investigation Report* shows the result of this analysis.

- The fifth method used evaluated PAHs and other non-ionic organic substances in sediment using the Toxic Unit (TU) approach. This method is described in EPA guidance (2003) and is based on the Target Lipid Model (Di Torro, 2000). Theoretically if a TU is > 1 then an adverse effect is likely to occur, however this method has an uncertainty factor of 2. Table 9-6 of the *Final Tier 2 Remedial Investigation Report* shows the result of this analysis.

There was a high correlation between the areas identified as unacceptable using the ERM-Q/PEL-Q method, and with the areas identified using the other lines of evidence. To simplify the sensitivity analysis and the Feasibility Study (FS), the results from the ERM-Q/ PEL-Q method were used to develop the RAOs and to establish the areas that need to be remediated due to risk to benthic invertebrates. Thirty of the seventy six sub-areas at the Site were categorized as a high or medium high risk to benthic invertebrates using the ERM-Q and PEL-Q method. The surface sediment ecological mean ERM and PEL Quotient results are shown on Figure 17.

The sediment to fish pathway was evaluated by comparing COPEC concentrations in fish tissue to literature derived tissue residue data. Whole body tissue samples of fish that feed on benthic invertebrates were collected and analyzed. The COPECs determined to be a potential risk to fish include aluminum, barium, iron, copper, lead, manganese, chromium, zinc, endosulfan II, and total PAHs.

COPEC concentrations in freshwaters were compared with appropriate ecological benchmarks. The data indicated that aquatic invertebrates and fish would be exposed to concentrations that could pose risk. Data indicate that some metals, pesticides, PCBs and volatiles exceeded their applicable benchmark. When comparing COPEC concentrations in saltwater with appropriate ecological benchmarks, data indicated that aquatic invertebrates and fish would be exposed to concentrations that might indicate some risk. Data indicate that some metals, pesticides and volatiles exceeded their applicable benchmark.

To assess the risk to aquatic organisms exposed to COPECs at the Site, ecological benchmarks from TCEQ (2006) were compared to the arithmetic mean and reasonable maximum exposure (RME) of surface water chemistry results collected during the Tier 1 RI in 2006 and during the Tier 2 RI in 2009.

- **2006 Data:** Thirty-two constituents, including eight metals, seven PCBs, eleven pesticides, three SVOCs, three PAHs and one VOC, had an HQ value greater than one based on ecological benchmark comparisons to either the arithmetic mean or RME in Tier 1 RI freshwater samples collected in 2006. In saltwater samples collected in 2006, 13 constituents, including four metals, eight pesticides, and two SVOCs, had an HQ value greater than one. The results of the arithmetic mean and RME-based ecological benchmark comparisons for 2006 surface water samples are summarized in Table 9-19 of the *Final Tier Two Remedial Investigation Report*.

- **2009 Data:** Twenty-five constituents, including five metals, seven PCBs, eight pesticides, three SVOCs, one PAH, and one VOC, had an HQ value greater than one based on ecological benchmark comparisons to either the arithmetic mean or RME in freshwater samples from 2009. In saltwater samples collected in 2009, 14 constituents, including four metals, eight pesticides, and two SVOCs, had an HQ value greater than one based on ecological benchmark comparisons. The results of the arithmetic mean and RME-based ecological benchmark comparisons for 2009 surface water samples are summarized in Table 9-19 of the *Final Tier Two Remedial Investigation Report*.

Some contaminants can be stored in plant and animal tissue and this can result in a buildup of the contaminant in animals that are higher in the food chain. The tropic level of an organism is the position that it occupies in the food chain. A UTL receptor is typically a bird, mammal or fish that consumes smaller insects, fish or animals Risk to UTL receptors was evaluated using food chain exposure models that utilized site specific dietary and media COPEC concentrations. Site specific exposure values were used when available. Estimates of total daily dose were calculated for each UTL receptor-COPEC pair and divided by an effects concentration to generate a HQ. The calculated HQs are provided in Table 9-23 of the *Final Tier 2 Remedial Investigation Report*. Fifteen UTL receptors were used as measurement endpoints in the food chain evaluation.

Risk was defined as low (or acceptable) if the HQ(no observable adverse effects level (NOAEL)) values are less than one. Risk was considered to be indeterminate if the HQ (NOAEL) >1 while the HQ(midpoint) and HQ(lowest observable adverse effects level (LOAEL)) <1. Risk was considered probable if the HQ (midpoint) >1 and the HQ (LOAEL) <1. Risk was considered high if the HQ (LOAEL) >1 or if a threatened and endangered species has a HQ (NOAEL) >1. The COPEC exposures that were addressed in the FS and sensitivity analysis are those that resulted in an indeterminate, probable, or high risk.

Two VOCs, ethylbenzene and carbon disulfide, indicated indeterminate and probable risk to the Spotted Sandpiper and the Marsh Wren, respectively. Exposure levels in the remaining thirteen receptor models had acceptable risk for VOCs. Pentachlorophenol had indeterminate exposure risks to the Spotted Sandpiper and high exposure risks to the Painted Turtle, Raccoon, and Short-Tailed Shrew. Benzaldehyde showed indeterminate exposure risk in the Belted Kingfisher model. PCBs evaluated as PCB congeners ($\sum$TEQ PCB) had indeterminate exposure risk to the Short-Tailed Shrew and the Raccoon. Total PAHs were determined to be a high risk to the Short-Tailed Shrew and an indeterminate risk to the Raccoon and Muskrat. Endosulfan II poses probable risk to the Raccoon and indeterminate risk to the American Robin, respectively. Risks to all upper trophic level receptors with the exception of the Brown Pelican, Green Heron, and Reddish Egret, indicated general risk from exposure to metals Site-wide. The results of the exposure model assessment indicated that no COPEC exposure posed unacceptable risk to the state endangered Brown Pelican, state threatened Reddish Egret, and Green Heron. The state threatened Wood Stork, White-Faced Ibis, and Alligator Snapping Turtle (using the Painted Turtle as a surrogate) were found to be at potential risk from exposure to several COPECs. The dietary item (daily dose) that contributed the majority of risk for receptor-COPEC pairs with HQ > 1 was identified to determine if risk was being driven by a particular environmental

medium (i.e. soil, sediment, surface water) or by a combination of lower trophic dietary items and ingestion of COPECs directly from the environment. Each receptor-COPEC pair with a HQ > 1 is discussed in the *Final Tier Two Remedial Investigation Report* Table 9-27.

The Sensitivity Analysis was completed to assess the reduction in Site-wide risk to upper trophic level receptors that would occur given a variety of remediation scenarios in sediment and soil. Most of the scenarios in the sensitivity analysis assumed that areas designated as a medium high risk or high risk to benthic invertebrates would be addressed. The remediation scenarios evaluated a variety of RGs as well as the sediment and soil locations that need to be addressed. The sensitivity analysis showed that if all polygon areas with an ERM-Q/ PEL-Q score of 3 (medium high priority) or 4 (high priority), along with the Jefferson Canal spoil pile are remediated to the RG values presented in Table 1, then risk to upper trophic level receptors would be acceptable. In the Sensitivity Analysis this scenario was identified as "10B". Table 1 shows all the COPECs for the Site. Figure 4 shows the location of the sub-areas or polygons included in scenario 10B. Figures 5 to 11 show the individual polygons that need to be addressed. Table 3 and Table 4 show the comparison of risk to UTL receptors with no remediation (Table 3) and the calculated risk following remediation using scenario 10B from the sensitivity analysis (Table 4). The comparison to other scenarios was presented in the sensitivity analysis.

14.4 Uncertainty

Some level of uncertainty is introduced into the risk characterization process every time an assumption is made. In regulatory risk assessment, the methodology and assumptions tend to err on the side of overestimating potential exposure and risk. The effect of using numerous assumptions that each overestimated potential exposure provides a conservative estimate of potential risk.

Data Evaluation Uncertainty: The purpose of data evaluation is to determine which chemicals are present at the site at concentrations requiring evaluation in the risk assessment. Uncertainty with respect to data evaluation can arise from many sources, such as the quality of the data used to characterize the site and the process used to select data included in the risk assessment. For some chemicals, the lab was not able to reliably measure chemical concentrations at the low values used for risk assessment benchmarks or ARARs. Because of this it is unclear whether these constituents (a) are not present at the Site, (b) are present, but at concentrations below the associated benchmarks, or (c) are present at concentrations above the associated benchmarks, but below the lab quantitation levels. Another source of uncertainty in data evaluation is the possibility that a chemical is present at the site that was not on the original list of chemicals that were analyzed. The original analyte list included a broad range of contaminants and was established after a careful review of site activities and site history, but it is possible that an important contaminant was not identified. The Star lake Canal site encompasses a large area and because of this each sample location is representative of a fairly large area. It is possible that some small areas with higher concentrations of contaminants were not identified due to the gap between sample locations.

Exposure assessment: Significant uncertainty exists in assumptions used to calculate chemical intakes from exposure to various media (e.g., rate of ingestion, frequency and duration of exposure, absorption efficiency). Conservative exposure factors (i.e., health-protective) are used when available information is limited. This may result in an overestimation of risk. Site specific values were used when available and in some cases calculated values were used.

Toxicity assessment: During the Ecological risk assessment toxicity reference values were established following an extensive review of scientific literature. In some cases data was not available for some COPEC-receptor combinations and values from similar species were used.

Risk Characterization: Generally, the goal of a risk assessment is to estimate an upper-bound, but reasonable, potential risk. Such an upper-bound estimate can be derived in several ways, depending on how conservative one wants the final estimate. In the HHRA and BERA, several upper-bound assumptions and numerous exposure pathways were combined to estimate potential risks. Most of the assumptions about exposure and toxicity used in the BHHRAs are representative of statistical upper-bounds or even maximums for each parameter. The result of combining several such upper-bound assumptions is that the final estimate of potential exposure or potential risk is conservative.

15.0 REMEDIAL ACTION OBJECTIVES

The basis for taking action at the Site is the finding that there is a medium high or a high probability of ecological toxicity in a number of areas for benthic invertebrates, and unacceptable risk for some UTL ecological receptors. There are no unacceptable human health risks at the Site and therefore no human health related RAOs are required. As presented in the risk assessment section above, the ecological risks to UTL ecological receptors at the Site include the following:

- Ethylbenzene and carbon disulfide are a probable risk to the Spotted Sandpiper and the Marsh Wren.
- Pentachlorophenol has high risks to the Painted Turtle, Raccoon, and Short-Tailed Shrew.
- Total PAHs create a high risk to the Short-Tailed Shrew.
- Endosulfan II poses a probable risk to the Raccoon.
- Risks from metals exposures to most upper trophic level receptors identified for the Site, including the White-Faced Ibis, Belted Kingfisher, Marsh Wren, Mallard, Muskrat, Raccoon, American Robin, Short-Tailed Shrew, Spotted Sandpiper, Painted Turtle, Wood Stork, and Bullfrog.
- The state threatened Wood Stork was found to be at potential risk from exposure to several COPECs including aluminum and antimony.
- The state threatened White-Faced Ibis was found to be at potential risk from exposure to several COPECs including aluminum, antimony, and lead.
- The state threatened Alligator Snapping Turtle (using the Painted Turtle as a surrogate) was found to be at potential risk from exposure to several COPECs including pentachlorophenol, aluminum, antimony, arsenic, chromium VI, and manganese.

RAOs describe what the proposed site cleanup is expected to accomplish. RAOs have been developed for the seven areas to be addressed by the proposed remedy. The RAOs specify the media type, contaminants of concern (COCs), potential exposure routes, receptors, and remediation goals. The cleanup levels become the final contaminant-specific cleanup levels in the Record of Decision (ROD). An RG establishes acceptable contaminant levels or range of levels for the exposure route. The PRG is developed during the RI/FS and is based on human health or ecological criteria established during the risk assessment or federal/state numeric standards considered by EPA to be Applicable or Relevant and Appropriate Requirements (ARARs). Standards that apply to a site but are not legally enforceable are treated as to-be-considered (TBC) standards for the Site.

ARARs that provide numeric standards as remediation goals for the Site are the Texas Water Quality Act regulations, Toxic Substances Control Act (TSCA), and Clean Water Act. The proposed remedy is consistent

with the Texas Risk Reduction Program (TRRP). Remedial action objectives have been developed for the seven areas that will be addressed by EPA's proposed cleanup plan. The proposed RAOs are:

- Protect benthic invertebrates by reducing direct contact exposure with COCs in areas where sediment is designated as medium-high priority (Level 3) or high priority (Level 4) ecological risk using ERM-Q/PEL-Q method.

- Protect upper trophic level (UTL) receptors by reducing ingestion/direct contact with sediment concentrations in excess of RGs in areas where sediment is designated as medium-high (3) or high priority (4) ecological risk using ERM-Q/PEL-Q method.

- Protect UTL receptors by reducing exposure to COPECs concentrations in excess of RGs in soil from the Jefferson Canal Spoil Pile.

Table 1 lists the RGs that have been established for this site and the contaminants of concern to achieve the RAOs; the development of the RGs is described below.

15.1 Development of Remedial Goals

Remedial goals were developed to address the ecological risk only as there were no unacceptable human health risks at the Site.

The first step was to develop Thiessen polygons using sediment and soil sample locations to establish areas to be used as decision units for the remedial action. Thiessen polygons are used to mathematically define individual areas around each of a set of sample points. The boundaries of each of these polygons define areas that are statistically closest to each point relative to all other points. So, if a particular point is found to contribute significantly to risk, then the boundary represented by the polygon surrounding that point would be considered to contribute significantly to that risk. The polygon boundaries were then refined based on geographical features to reduce the number of habitat types included in each polygon.

Next, a sensitivity analysis was performed on various remediation scenarios to evaluate the contributions of the various soil and sediment sample areas to overall Site risk. The sensitivity analysis determined that the percentage of risk reduction ranged from 0% in the scenario that modeled no remediation to 72.06% in the scenario that modeled remediation of the benthic invertebrate risk areas and all of the Jefferson Canal Spoil Pile, which was in Remediation Scenario 10B. The evaluated sediment PRGs included the first effects benchmarks, ½ of the first effects benchmarks, and the detection limits. A higher risk reduction for sediment was generally found if the remediated polygons were remediated to ½ of the first effects benchmarks.

The RGs used for sediment, shown in Table 1, are, for most COPECs, ½ of the first effects benchmarks from TCEQ's *Update to Guidance for Conducting Ecological Risk Assessments at Remediation Sites in Texas, RG-263, Table 3-3, Revised 2006.* For antimony, selenium, and vanadium, the RGs were obtained from the EPA Region 3 Sediment Screening Benchmarks. For Endosulfan II, the RG was obtained from EPA Region 3 Biological Technical Assistance Group Screening Benchmarks. (http://www.epa.gov/reg3hwmd/risk/eco/index.htm). For carbon disulfide, a benchmark for salt water is unavailable, so the freshwater RG was used for both fresh and saltwater. The chromium RG was based on a total hardness of 100 mg/L as CaCO3. Finally, the chromium VI RG was based on the lowest measured concentration at the Site because there is no benchmark available. For most COPECs in soils, the RG was obtained from the Texas Median Background concentrations in Table 3-4 of TCEQ's *Update to Guidance for*

Conducting Ecological Risk Assessments at Remediation Sites in Texas, RG-263, Revised 2006. Additional details regarding RG selection are available in the *Final Feasibility Study Report*.

The risk to benthic invertebrates was selected as the priority when identifying the polygons to be addressed in the sensitivity analysis. After these polygons were chosen for remediation, then exposure to UTL receptors was evaluated based on remediation of those polygons. Results from Remediation Scenario 10B indicated acceptable risk levels for most of the COPECs that were evaluated in the sensitivity analysis following remediation. However, the following COPECs, including pentachlorophenol, aluminum, hexavalent chromium, copper, and manganese, were found to still pose risk to UTL receptors. These COPECs were assessed for conservative measures that could be contributing to the remaining risk as well as issues that can help better define the risk to UTL receptors such as bioavailability due to soil chemistry. This assessment was necessary because a remediation of all sediment to detection limits and all soil to background levels resulted in continued risk at the Site, indicating that there may be a number of conservative measures incorporated into the exposure modeling.

After conservative measures were identified, modifications were made to the exposure models to better define the risk posed by these COPECs. Modifications to these COPECs included adjustments to the dietary components of the alligator snapping turtle surrogate species (painted turtle), using the $HQ_{[LOAEL]}$ to measure risk, using soil pH levels and AVS/SEM ratios to determine bioavailability, setting non-detect sample concentrations at half detection limits, and using a more appropriate manganese Toxicity Reference Value (TRV) for avian receptors and mammals. These modifications are described in more detail in the *Final Feasibility Study Report*. These modifications were made to provide a more realistic prediction of risk to UTL receptors following remediation. With these modifications, all COPECs were found to pose acceptable risk levels following remediation based on Remediation Scenario 10B.

16.0 DESCRIPTION OF REMEDIAL ALTERNATIVES

16.1 Statutory Requirements/Response Objectives

Under its legal authorities, EPA's primary responsibility at Superfund sites is to undertake remedial actions that are protective of human health and the environment. In addition, Section 121 of CERCLA, 42 U.S.C. § 9621, establishes several other statutory requirements and preferences, including: (1) a requirement that EPA's remedial action, when complete, must comply with all applicable, relevant, and appropriate federal and more stringent state environmental and facility siting standards, requirements, criteria or limitations, unless a waiver is invoked; (2) a requirement that EPA select a remedial action that is cost-effective and that utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and (3) a preference for remedies in which treatment permanently and significantly reduces the volume, toxicity, or mobility of the hazardous substances. Response alternatives were developed to be consistent as appropriate with these statutory mandates.

16.2 Technology and Alternative Development and Screening

CERCLA and the NCP set forth the process by which remedial actions are evaluated and selected. In accordance with these requirements, a range of alternatives were considered in the FS to address the contamination at the Site. The remedial alternatives discussed in this ROD were developed by choosing appropriate technologies from among those considered in the FS. Although all the considered technologies have proven themselves to be applicable for remediating the COCs present at the Site, some of the technologies are not expected to be effective at the Site. Others, while potentially effective, were not deemed

sufficiently efficient for serious consideration. In summary, forty three preliminary remedial alternatives were evaluated as part of the Feasibility Study. The thirty nine alternatives that were retained for detailed analysis are described below.

16.3 Common Elements

All of the AOIs with the exception of the Jefferson Canal Spoil Pile contain sediment that needs to be addressed. Many of the alternatives that were evaluated in each AOI contain common elements. A general description of these elements is provided below.

1. **No Action:** Consideration of a No Action response is required by the *EPA Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (EPA, 1988)*. The No Action response has been included to provide a basis for the comparison of the remaining general response actions. Under this response, No Action would be taken to isolate, remove, treat, or contain COCs in the sediment or soil at the Site. COC-affected media would remain in place and the potential for continued migration of constituents would not be mitigated. Additionally, no controls would be implemented to prevent intrusive activities, such as benthic invertebrate burrowing into the affected sediment.

2. **Monitored Natural Recovery (MNR):** MNR is a response for COC-affected sediment that uses natural processes (i.e., degradation, transport of sediments) to contain, destroy, or reduce toxicity or the bioavailability of constituents. Multiple natural occurring processes may be optimized to isolate, degrade, and remove COCs from the benthic environment. MNR is a gradual process, with a recovery time of years to decades. MNR types include chemical/physical processes, biological processes, and physical processes. The chemical/physical transport process option optimizes the natural activities of sorption, desorption, dispersion, diffusion, dilution, volatilization, re-suspension, and transport. The timeframe for this process option varies with each activity, COC, and site condition. The biological degradation process option optimizes the natural attenuation of COCs by native aerobic or anaerobic bacteria. PCBs and pesticides may be dechlorinated, and PAHs, SVOCs, and VOCs may be partially or completely degraded. The physical burial process option optimizes natural sedimentation and deposition to bury the affected materials in place. Additional deposition of clean sediment into the environment may lead to natural placement of an isolation layer between COC-affected sediments and the water column.

The MNR response has low to high long-term effectiveness depending on the Site conditions. The implementability of MNR is high because minimal action is taken, and all implementation can be performed using commercially available materials, equipment, and personnel for the required sampling. Where MNR is selected as a remedial alternative, a plan for monitoring and determining the effectiveness of MNR, including sampling, will be developed during the Remedial Design. Sampling will also be performed during the Remedial Design to establish the baseline conditions prior to MNR implementation. The monitoring and sampling program will contain elements designed to reflect reductions in contaminant concentration, exposure, and bioavailability. Further, semi-annual inspections will be conducted at the Site every year. The sections below describing the comparative analysis of the alternatives discuss why MNR was selected for certain areas; those areas either have a less than high priority (Level 4) ecological priority, or are not accessible for construction purposes. Historical anecdotal information indicates that the Site has been generally recovering over time.

3. **Containment:** Containment includes a range of options by which the pathway between constituents and the environment is interrupted by a physical barrier. This barrier eliminates direct contact between benthic invertebrates and constituent affected sediment and soil, and discourages constituent migration or

prevents erosion of affected sediments and soil. Examples of containment techniques potentially appropriate for the Site include soil caps, clay caps, composite caps, armored caps, and erosion control mats. The soil cap process option is implemented by covering affected sediment or soil with clean top soil to isolate COCs from the surrounding environment. Soil caps are not impermeable, making them better suited for containment of COC affected soils in non-aquatic environments than for use in aquatic environments where migration of COCs to the water column, and benthic invertebrate burrowing, may not be sufficiently inhibited. The clay cap process option is implemented by covering affected sediment or soil with clean clay material to isolate COCs from the surrounding environment. When saturated, the clay caps form a continuous, impermeable barrier between constituent affected sediments and the water column. This option provides long-term protection of benthic invertebrates and the environment, and produces a new benthic habitat, although not as good as a soil cap. In high water velocity settings, clay caps are resistant to erosion, and can additionally be reinforced by an armored cap. Clay caps can also be used for containment of soils in non-aquatic environments. Both armored caps and erosion control mats serve to reduce erosion and bioturbation. An armored cap consists of a layer of cobbles, pebbles, or other large material and prohibits disturbance by its ability to prevent burrowing by organisms, stabilize materials, and prevent erosion. Regarding the type, location, thickness, etc., of the various capping materials, the descriptions provided in this ROD are based on preliminary considerations based on the Site conditions as now understood. The Remedial Design will include additional data collection on Site conditions, and this additional information may indicate that some revisions to the cap types described here may be necessary. Therefore, the Remedial Design will determine the final types, locations, thickness, etc., of the caps. An erosion control mat consists of a lightweight aggregate contained within a poly-mesh exterior, and can both prevent erosion and provide stable marsh habitat, where applicable. An erosion control mat serves to protect the environment by partially inhibiting the migration of COC affected sediment by reduction of erosion, and by additionally trapping sediments and organic debris for marsh establishment. The lightweight aggregate within the mat allows it to lie atop existing sediment without sinking, highly reducing disruption caused by installation compared to other alternatives.

The composite cap process option consists of some combination of soil, clay, and optional stabilizing media or geotextile (synthetic fabric for additional stabilization) placed over sediments or soils to inhibit migration of impaired pore water and to discourage bioturbators such as burrowing invertebrates. Composite cap mixtures include the use of a variety of materials to form the stabilizing aggregate; bentonite clay, other clay particles, or polymers are used frequently. When compared to sand caps, composite caps may reduce the necessary cap thickness by more than 90 percent. The soil cap and pipe process option encloses the channel flow within a pipe designed to meet necessary hydraulic capacity. The impacted sediments no longer have contact with the flowing water and may be capped in place with a layer of soil or clay.

The containment response action has high effectiveness because COCs are isolated from the environment on a long-term basis. Typical estimated breakthrough of organic COCs for most clay caps, composite caps, or containment pipes, is on the order of hundreds of years. The isolation provided by the containment response action is also effective on a short-term basis, though during implementation COC-affected sediments may be temporarily re-suspended in the water column. Implementability of the containment response action is low to high depending on Site conditions and the potential to damage portions of Molasses Bayou Waterway and Wetlands AOIs. All of the containment technologies can be implemented using commercially available materials, equipment, and personnel. Administrative responsibilities would include rental of appropriate equipment, and coordination with multiple vendors for containment material delivery. The cost of the containment response action is moderate to high, depending upon area conditions and includes materials, transportation, and monitoring. In general, materials for a clay cap have the lowest cost and are locally available; materials for a composite cap will include some clay and other materials, which may be produced and transported by specific non-local suppliers.

Another component of a containment remedy is the application of institutional controls. The purpose of institutional controls is to provide information associated with each tract of land on the Site regarding the location of the cap, and to protect the integrity of the cap by limiting any digging or dredging in the area that could interfere with the performance of the cap. Institutional controls in the State of Texas enforceable by the TCEQ shall be filed in compliance with 30 TAC Chapter 350 Subchapter F (Institutional Controls). Information to be contained in the institutional controls will be collected as part of Remedial Design to the extent practicable. Institutional controls shall be filed in the records of the county in which the Site is located as early as practicable in the remedial process, but not later than construction completion. The remedial action is not complete until institutional controls are filed among the property records in the county where the Site is located.

Consistent with the "Enforcement First" policy, prior to committing federal funds to Site response, EPA will seek to have Potentially Responsible Parties (PRPs, including Site owners if any) fund or conduct the remedial action. For Fund-lead and PRP-lead remedial actions alike, institutional controls shall be implemented in accordance with 30 TAC Chapter 350, Subchapter F, and approved by the EPA and the TCEQ.

4. **Removal and Disposal:** The removal and disposal alternative involves extraction of the affected sediments or soils by excavation or dredge, followed by disposal of those materials at an appropriate off-Site facility. Several remedial alternatives include removal of approximately twelve inches of impacted soil or sediment in applicable sub-areas in each AOI. Twelve inches is considered the biologically active zone for the purpose of eliminating ecological risk to potential receptors. The excavation process involves the removal of affected sediments using standard heavy equipment, excavation attachments on a marsh buggy, or similar amphibious heavy equipment. Following excavation, constituent affected sediments can be disposed at an approved off-Site landfill. A set-back or servitude will not be disturbed within 25 feet of the pipelines extending through the various areas. In general, no heavy equipment will be used to implement any remedial alternative over the pipeline servitude areas. The hydraulic dredge process option is an appropriate removal alternative for sites involving underwater sediments with low accessibility. During hydraulic dredging a pump provides suction to move the sediment slurry through a pipeline to a land-based dewatering area. All removed sediment would be dewatered, if needed, and properly disposed off-Site. These excavated areas shall be backfilled with clean fill and stabilized along the bottom and sides of the canals. Additionally, sediment and erosion control best management practices such as silt curtains will be installed in the canals to prevent the migration of COC-affected sediments resuspended during the excavation process.

16.4 Summary of Remedial Alternatives

Alternatives Selected for Detailed Analysis: Multiple alternatives were developed for each AOI. These alternatives were evaluated to select the one that is best suited for the AOI and that best satisfies the evaluation criteria. A more detailed explanation of each alternative can be found in Section 4 of the Final Feasibility Study Report. A summary of the alternatives is provided below.

16.4.1 Jefferson Canal AOI *(Polygons JC-2, JC-7, JC-13, JC-18, JC-19, Shown on Figure 5)*

Alternative 1:	No Action
Alternative 2a:	Soil Cap and Pipe Containment of JC-7; 12-inch Removal/Disposal; and Containment with a 12-inch soil cap; no pipeline servitude removal or containment.

Alternative 2b: Soil Cap and Pipe Containment of JC-7; 12-inch Removal/Disposal; and Containment with a 12-inch soil cap on area outside the pipeline servitude and 12-inch Erosion Control Mat on the pipeline servitude.

Alternative 2c: Soil Cap and Pipe Containment of JC-7; 12-inch Removal/Disposal; and Containment with a 12-inch Armored Cap.

Alternative 2d: Soil Cap and Pipe Containment of JC-7; 12-inch Removal/Disposal; and Containment with a 12-inch Armored Cap on area outside the pipeline servitude and 12-inch Erosion Control Mat on the pipeline servitude.

Alternative 3a: 12-inch Removal/Disposal; and Containment with a 12-inch soil cap.

Alternative 3b: 12-inch Removal/Disposal; and Containment with a 12-inch soil cap on area outside the pipeline servitude and 12-inch Erosion Control Mat on the pipeline servitude

Alternative 3c: 12-inch Removal/Disposal; and Containment with a 12-inch Armored Cap.

Alternative 3d: 12-inch Removal/Disposal; and Containment with a 12-inch Armored Cap on area outside the pipeline servitude and 12-inch Erosion Control Mat on the pipeline servitude.

16.4.2 Jefferson Canal Spoil Pile AOI *(Polygons JCSP- 1 through JCSP-25, inclusive, and JC-8, JC-9, JC-10, and JC-11 Shown on Figure 6)*

Alternative 1: No Action.

Alternative 2a: Containment with a 2-foot Composite Cap.

Alternative 2b: Removal/Disposal of mounds to grade; and Containment with a 2-foot Composite Cap.

Alternative 2c: Partial Containment with a 2-foot Composite Cap.

Alternative 3a: 12-inch Removal/Disposal; Removal/Disposal of mounds to grade; and Containment with a 2-foot Composite Cap.

Alternative 3b: 12-inch Removal/Disposal; Removal/Disposal of mounds to grade; and Partial Containment with a 2-foot Composite Cap.

16.4.3 Former Star Lake AOI *(Polygons SL-6, SL-7, SL-9, and SL-10 Shown on Figure 7)*

Alternative 1: No Action.

Alternative 2a: 12-inch Removal/Disposal; and Containment with a 12-inch Clay Cap (minimizes erosion).

Alternative 2b: 12-inch Removal/Disposal; and Containment with a 12-inch Clay Cap (minimizes erosion) on area outside the pipeline servitude; and 12-inch Erosion Control Mat and 12-inch Composite Cap on the pipeline servitude.

Alternative 3a: 12-inch Removal/Disposal; and Containment with a 12-inch Composite Cap.

Alternative 3b: 12-inch Removal/Disposal; and Containment with a 12-inch Composite Cap on area outside the pipeline servitude; 12-inch Erosion Control Mat and 12-inch Composite Cap on the pipeline servitude.

16.4.4 Star Lake Canal AOI *(Polygons SLC-6 and SLC-11 Shown on Figure 8)*

Alternative 1: No Action.

Alternative 2: 12-inch Removal/Disposal; and Containment with a 12-inch Clay Cap (minimizes erosion).

Alternative 3: 12-inch Removal/Disposal; and Containment with a 12-inch Armored Cap.

16.4.5 Gulf States Utility Canal AOI *(Polygons GSUC-7 Shown on Figure 9)*

Alternative 1: No Action.
Alternative 2: Containment with a 12-inch Composite Cap.
Alternative 3: 12-inch Removal/Disposal; and Containment with a 12-inch Armored Cap.
Alternative 4: 12-inch Removal/Disposal.

16.4.6 Molasses Bayou Waterway AOI *(Polygons MB-10, MB-14, MB-18/MB-18R, MB-21, MB-24, MB-49, MB-52, MB-54, MB-60, MB-61 Shown on Figure 10)*

Alternative 1: No Action.
Alternative 2a: Monitored Natural Recovery.
Alternative 2b: Monitored Natural Recovery *(Polygons MB-10, MB-14, MB-18/MB-18R, MB-49, MB-52, MB-54 MB-60)*; and 12-inch Removal/Disposal; and Containment with a 12-inch Armored Cap *(Polygons MB-21, MB-24,MB-61).*
Alternative 3: 12-inch Removal/Disposal; and Containment with a 12-inch Armored Cap.

16.4.7 Molasses Bayou Wetland AOI *(Polygons MB-26, MB-51, MB-56, MB-58, MB-59, MB-62, MB-63 Shown on Figure 11)*

Alternative 1: No Action.
Alternative 2a: Monitored Natural Recovery.
Alternative 2b: Monitored Natural Recovery *(Polygons MB-51, MB-56, MB-58,MB-59)*; and Containment with a 12-inch Composite Cap *(Polygons MB-26, MB-62, MB-63).*
Alternative 2c: Monitored Natural Recovery *(Polygons MB-51, MB-56, MB-58,MB-59)*; and 12-inch Removal/Disposal; and Containment with a 12-inch Armored Cap *(Polygons MB-26, MB-62, MB-63).*
Alternative 2d: Monitored Natural Recovery *(Polygons MB-51, MB-56, MB-58,MB-59)*; and 12-inch Removal/Disposal *(Polygons MB-26, MB-62, MB-63).*
Alternative 3: Containment with a 12-inch Composite Cap.
Alternative 4: 12-inch Removal/Disposal; and Containment with a 12-inch Armored Cap.
Alternative 5: 12-inch Removal/Disposal.

17.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

17.1 Remedial Alternative Evaluation Criteria

The NCP, 40 CFR Part 300, requires EPA to evaluate remedial alternatives against nine criteria to determine which alternative is preferred. The first two criteria are referred to as the "Threshold Criteria." They are overall protection of human health and the environment, and compliance with ARARs. Response actions under CERCLA must satisfy the Threshold Criteria. The next five criteria are referred to as the "Balancing Criteria." They are long-term effectiveness and permanence, reduction of toxicity, mobility or volume through treatment, short-term effectiveness, implementability, and cost. These criteria represent a balance of trade-offs with regards to each alternative. The EPA applies these seven criteria during the Detailed Analysis of Alternatives phase of the FS to identify the relative advantages and disadvantages of each alternative for decision-making. The remaining two criteria (community and state acceptance) are referred to as "Modifying

Criteria". They are applied after EPA presents the preferred alternative and its rationale for such preference to the state, and subsequently to the public in the Proposed Plan. The nine evaluation criteria defined in the NCP are the following:

Threshold Criteria:

Overall Protection of Human Health and the Environment: Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled through treatment, engineering controls and/or institutional controls.

Compliance with Applicable or Relevant and Appropriate Requirements: Section 121 (d) of CERCLA and NCP §300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, limitations which are collectively referred to as "ARARs," unless such ARARs are waived under CERCLA section 121(d)(4) and NCP §300.430(f)(1)(ii)(C). The ARARs for the Site are listed in Table 5 (Chemical Specific ARARs), in Table 6 (Location Specific ARARs), and Table 7 (Action Specific ARARs).

Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. State standards that are identified by a state in a timely manner and that are more stringent than Federal requirements may be applicable. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site. Only those State standards that are identified in a timely manner and are more stringent than Federal requirements may be relevant and appropriate. Finally, there is a category of other federal or state advisories, criteria, or guidance, which may be used to develop a CERCLA remedy that falls into a category called "to be considered (TBC)" guidelines 40 C.F.R. § 300.400(g)(3). TBC criteria are non-promulgated, non-enforceable guidelines, or criteria that may be useful for developing a remedial action or that are necessary for evaluating what is protective to human health and/or the environment. Examples of TBC criteria include EPA reference doses and cancer slope factors. TBC guidance documents referenced in conducting the risk assessments include *Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual (Part A),* December 1989, *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessment, Interim Final*, June 1997, and *Guidelines for Ecological Risk Assessment,* April 1998.

Balancing Criteria:

Long-Term Effectiveness and Permanence: Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup levels have been met. This criterion includes the consideration of residual risk that will remain on-site following remediation and the adequacy and reliability of controls.

Reduction of Toxicity, Mobility, or Volume through Treatment: Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.

Short-Term Effectiveness: Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community and the environment during construction and operation of the remedy until cleanup levels are achieved. Included with this evaluation is an estimate of the natural resources to be consumed and increased emissions to be produced for each alternative.

Implementability: Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.

Cost: Cost includes estimated capital and annual operations and maintenance costs, as well as present value costs.

Modifying Criteria:

State/Support Agency Acceptance: This criterion considers whether the State agrees with the EPA's analyses and recommendations, as described in the RI/FS and Proposed Plan.

Community Acceptance: Community acceptance considers whether the local community agrees with EPA's analyses and preferred alternative. Comments received on the Proposed Plan are an important indicator of community acceptance. This criterion will be fully considered after the public comment period.

17.2 Comparative Analysis of Remedial Alternatives

This section presents the comparative analysis of the remedial alternatives developed for each of the seven AOIs. The objective of the comparative analysis is to identify the advantages and disadvantages of each remedial alternative relative to one another within an AOI, and provide key information for use in determination of the selected remedy. The nine criteria discussed in detail above are used to compare the remedial alternatives for each AOI.

A construction time estimate of one year was used for all of the alternatives evaluated in the Feasibility Study. This estimate was used based on the requirements for the Feasibility Study. A more detailed estimate of the construction time will be developed as a part of the detailed plans and designs prepared during the Remedial Design phase.

17.2.1 Jefferson Canal Comparative Analysis

Jefferson Canal Alternative 1:

- **Technology and Process Option:** No Action.
- **Summary:** No remedial action taken; therefore no reduction of exposure between benthic invertebrates and COCs.
- **Overall Protection of Human Health and the Environment:** Alternative would not provide protection from COCs to the environment.

- **Compliance with ARARs:** Not compliant with requirements because no remedial action has been taken.
- **Long-Term Effectiveness and Permanence:** Alternative would provide a low level of long-term effectiveness and permanence because it would not result in any significant change in the risks associated with COC affected sediment.
- **Reduction of Toxicity, Mobility, or Volume through Treatment:** This alternative provides no reduction in toxicity, volume, or mobility of COCs.
- **Short-Term Effectiveness:** The short-term effectiveness of this alternative is not applicable since no actions are taken.
- **Implementability:** Not applicable since no actions are taken.
- Cost: $0

Jefferson Canal Alternative 2a:

1. **Technology and Process Option 2a**: Containment with Soil Cap and Pipe at JC-7; 12-inch Removal/Disposal outside of pipeline servitude; and Containment with a 12-inch soil cap outside of pipeline servitude. There will be no removal or containment within the pipeline servitude.
2. **Summary:** Containment with a Soil Cap and Pipe is feasible along specific portions of Jefferson Canal downstream from Hogaboom Road in the area of the polygon that corresponds to sample number JC-7. 12-inch removal/disposal and containment with a 12-inch soil cap is applicable in the sub-areas associated with sample locations JC-2, JC-13, JC-18, and JC-19. The excavated material would be transported directly into trucks for removal from the Site. The pipeline servitudes will not be excavated or contained with this alternative.
3. **Overall Protection of Human Health and the Environment:** Pipe containment and soil cap at JC-7 will provide a barrier between benthic invertebrates and the COCs. 12-inch removal and 12-inch soil cap at JC-2, JC-13, JC-18, and JC-19 will provide elimination of the COC-affected sediment and a permanent disruption of the pathway between the potential receptors and the COCs to areas outside the pipeline servitude. Excavation will require the sediment to be dewatered (possibly treated) and disposed. Containment with a 12-inch soil cap will restore the canal to its pre-excavation depth and provide a new benthic habitat to the areas outside the pipeline servitude. This alternative does not meet the threshold criterion of overall protection of environment for 6 percent of the polygons to be remediated because the COC affected material in the pipeline servitude (6 percent) area is not removed or contained. The RAOs will be achieved at the completion of the remedy construction.
4. **Compliance with ARARs:** This alternative will comply with the chemical, action, and location ARARs listed in Tables 5, 6, and 7, including the Clean Water Act, Floodplain Management requirements, the Fish and Wildlife Coordination Act, and the National Historical Preservation Act. The Alternative also provides a moderate level of long term effectiveness and permanence because COC affected sediments are permanently isolated for areas outside the pipeline servitude.
5. **Long-Term Effectiveness and Permanence:** Alternative provides a moderate level of long term effectiveness and permanence because COC affected sediments are permanently isolated for areas outside the pipeline servitude.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Alternative reduces mobility and volume of COC affected sediments to areas outside the pipeline servitude. The pipe further isolates any remaining sediment. There is no reduction of toxicity, mobility, or volume for the pipeline servitude areas.
7. **Short-Term Effectiveness:** Short term effectiveness depends upon the duration of implementation, the time it takes to sandbag and dewater the area, excavate approximately one foot of sediment, lay geotextile or a thin layer of sand, set precast concrete pipe, backfill to grade, and vegetatively stabilize

the canal. This remedial action of the alternative provides immediate relief from exposure to affected sediment upon implementation. Additionally, care will be taken to install best management practices such as silt curtains to trap any affected sediment that may become suspended in the water column by the excavation process.

8. **Implementability:** Alternative has a high degree of implementability. Materials and equipment are readily available. During implementation, logistical considerations will include proper timing of water diversion during preparation and pipe placement, staging requirements for backfill and equipment, and development of an erosion control plan to keep COC affected sediment out of the waterway. A hydraulic analysis will be conducted during the design to verify that the capacity of the pipe is adequate for current flow and will safely convey the design event.
9. **Cost:**

Base Implementation Cost:	$353,000
Remediation and Disposal Cost:	$1,066,000
Present Worth Operation & Maintenance Cost:	$75,000
Estimated Total Cost:	$1,494,000

Jefferson Canal Alternative 2b

1. **Technology and Process Option 2b:** Containment with a Soil Cap and Pipe at JC-7; 12-inch Removal/Disposal; and Containment with a 12-inch soil cap on area outside the pipeline servitude; and a 12-inch Erosion Control Mat on the pipeline servitude.
2. **Summary:** Containment with a Soil Cap and Pipe is feasible along specific portions of Jefferson Canal downstream from Hogaboom Road in the area of the polygon that corresponds to sample number JC-7. 12-inch removal/disposal and containment with a 12-inch soil cap is applicable in the sub-areas associated with sample locations JC-2, JC-13, JC-18, and JC-19 outside the pipeline servitude. The pipeline servitude will be contained with a 12-inch erosion control mat. The excavated material would be transported directly into trucks for removal from the Site.
3. **Overall Protection of Human Health and the Environment:** Pipe containment and soil cap at JC-7 will provide a barrier between benthic invertebrates and the COCs. 12-inch removal and a 12-inch soil cap at JC-2, JC-13, JC-18, and JC-19 will provide protection of the environment through the elimination of the COC-affected sediment and a permanent disruption of the pathway between the potential receptors and the COCs to areas outside the pipeline servitude. Excavation will require the sediment to be dewatered (possibly treated) and disposed. Containment with a 12-inch soil cap will restore the canal to its pre-excavation depth and provide a new benthic habitat to the areas outside the pipeline servitude. An erosion control mat inhibits the migration of COC affected sediment by reduction of erosion, additionally trapping sediments and organic debris for marsh establishment. The RAOs will be achieved at the completion of the remedy construction.
4. **Compliance with ARARs:** This alternative will comply with the chemical, action, and location ARARs listed in Tables 5, 6, and 7, including the Clean Water Act, Floodplain Management requirements, the Fish and Wildlife Coordination Act, and the National Historical Preservation Act.
5. **Long-Term Effectiveness and Permanence:** Alternative provides a high level of long term effectiveness and permanence because COC affected sediments are permanently isolated for areas outside the pipeline servitude. The lightweight aggregate clay within the erosion control mat will remain in place, stabilizing the sediment, and population by marsh plants will increase both effectiveness and permanence.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Alternative reduces mobility and volume of COC affected sediments. The pipe further isolates any remaining sediment.

7. **Short-Term Effectiveness:** Short term effectiveness depends upon the duration of implementation, the time it takes to sandbag and dewater the area, excavate approximately one foot of sediment, lay geotextile or a thin layer of sand, set precast concrete pipe, backfill to grade, and vegetatively stabilize the canal, and lay the erosion control mat. This remedial action of the alternative provides immediate relief from exposure to affected sediment upon implementation. Once the sediment is removed and a 12-inch soil cap is used for stabilization of the canal, the risk to benthic invertebrates from exposure to COC affected sediment is eliminated. Additionally, care will be taken to install best management practices such as silt curtains to trap any affected sediment that may become suspended in the water column by the excavation process. Implementation of the erosion control mat alternative provides a highly effective barrier between COC affected sediments and wave action or other erosive forces.
8. **Implementability:** Alternative has a high degree of implementability. Materials and equipment are readily available. During implementation, logistical considerations will include proper timing of water diversion during preparation and pipe placement, staging requirements for backfill and equipment, and development of an erosion control plan to keep COC affected sediment out of the waterway. A hydraulic analysis will be conducted during the design to verify that the capacity of the pipe is adequate for current flow and will safely convey the design event. Additionally, the removed COC affected sediment must be dewatered and disposed at an authorized facility.
9. **Cost:**

Base Implementation Cost	$353,000
Remediation and Disposal Cost	$1,073,000
Present Worth Operation & Maintenance Cost	$75,000
Estimated Total Cost	$1,501,000

Jefferson Canal Alternative 2c

1. **Technology and Process Option 2c:** Containment with Soil Cap and Pipe at JC-7; 12-inch Removal/Disposal; and Containment with a 12-inch Armored Cap. There will be no removal or containment within the pipeline servitude.
2. **Summary:** Containment with a Soil Cap and Pipe is feasible along specific portions of Jefferson Canal downstream from Hogaboom Road in the area of the polygon that corresponds to sample number JC-7. 12-inch removal/disposal and containment with a 12-inch armored cap is applicable in the sub-areas associated with sample locations JC-2, JC-13, JC-18, and JC-19. The excavated material would be transported directly into trucks for removal from the Site. This alternative is feasible because the COC affected sediments can be removed from the AOI. The pipeline servitudes will not be excavated or contained with this alternative, so 6 percent of the AOI will not be remediated.
3. **Overall Protection of Human Health and the Environment:** Pipe containment and soil cap at JC-7 will provide a barrier between benthic invertebrates and the COCs. 12-inch removal and 12-inch armored cap at JC-2, JC-13, JC-18, and JC-19 will provide protection of the environment through the elimination of the COC-affected sediment and a permanent disruption of the pathway between the potential receptors and the COCs to areas outside the pipeline servitude. Excavation will require the sediment to be dewatered (possibly treated) and disposed. Containment with a 12-inch armored cap provides resistance from erosion. An armored cap does inhibit the migration of COC affected sediment by reduction of erosion. This alternative does not meet the threshold criterion of overall protection of environment for 6 percent of the sub-areas to be remediated because the COC affected material in the pipeline servitude (6 percent) area is not removed or contained. The RAOs will be achieved at the completion of the remedy construction.

4. **Compliance with ARARs:** This alternative will be designed to comply with chemical, action, and location specific ARARs for areas outside the pipeline servitude. The COC-affected material remaining in the pipeline servitude (6 percent) area may not comply with ARARs for the Site.
5. **Long-Term Effectiveness and Permanence:** Alternative provides a moderate level of long term effectiveness and permanence because COC affected sediments are isolated for areas outside the pipeline servitude. There is a high level of long-term effectiveness for an armored cap because of the prevention and reduction of erosion.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Alternative reduces mobility and volume of COC affected sediments to areas outside the pipeline servitude. The pipe further isolates any remaining sediment. There is no reduction of toxicity, mobility, or volume for the pipeline servitude areas. An armored cap further reduces mobility through the prevention of erosion.
7. **Short-Term Effectiveness:** Short term effectiveness depends upon the duration of implementation, the time it takes to sandbag and dewater the area, excavate approximately one foot of sediment, lay geotextile or a thin layer of sand, set precast concrete pipe, backfill to grade, and vegetatively stabilize the canal. This alternative provides immediate relief from exposure to affected sediment upon implementation. Once the sediment is removed and a 12-inch armor cap is used for stabilization of the canal, the risk to benthic invertebrates from exposure to COC affected sediment is eliminated. An armor caps ability to reduce erosion is effective immediately after installation. Additionally, care will be taken to install best management practices such as silt curtains to trap any affected sediment that may become re-suspended in the water column by the excavation process.
8. **Implementability:** Alternative has a high degree of implementability. Materials and equipment are readily available. During implementation, logistical considerations will include proper timing of water diversion during preparation and pipe placement, staging requirements for backfill and equipment, and development of an erosion control plan to keep COC affected sediment out of the waterway. A hydraulic analysis will be conducted during the design to verify that the capacity of the pipe is adequate for current flow and will safely convey the design event.
9. **Cost:**

Base Implementation Cost	$353,000
Remediation and Disposal Cost	$1,278,000
Present Worth Operation & Maintenance Cost	$75,000
Estimated Total Cost	$1,706,000

Jefferson Canal Alternative 2d

1. **Technology and Process Option 2d:** Containment with a Soil Cap and Pipe at JC-7; 12-inch Removal/Disposal; and Containment with 12-inch Armored Cap on area outside the pipeline servitude; and a 12-inch Erosion Control Mat on the pipeline servitude. The pipe will contain and isolate the surrounding contaminated media from the environment.
2. **Summary:** Containment with a Soil Cap and Pipe is feasible along specific portions of Jefferson Canal downstream from Hogaboom Road in the area of the polygon that corresponds to sample number JC-7. 12-inch removal/disposal and containment with a 12-inch armored cap is applicable in the sub-areas associated with sample locations JC-2, JC-7, JC-13, JC-18, and JC-19 outside the pipeline servitude. The pipeline servitude will be contained with a 12-inch erosion control mat. The excavated material would be transported directly into trucks for removal from the Site. This alternative is feasible because COC affected sediments can be removed from the AOI.
3. **Overall Protection of Human Health and the Environment:** Pipe containment and soil cap at JC-7 will provide a barrier between benthic invertebrates and the COCs. 12-inch removal and a 12-inch armored cap at JC-2, JC-13, JC-18, and JC-19 will provide protection of the environment through the

elimination of the COC-affected sediment and a disruption of the pathway between the potential receptors and the COCs to areas outside the pipeline servitude. Excavation will require the sediment to be dewatered (possibly treated) and disposed. Containment with a 12-inch armored cap will restore the canal to its pre-excavation depth and provide resistance to erosion. An erosion control mat inhibits the migration of COC affected sediment by reduction of erosion, additionally trapping sediments and organic debris for marsh establishment. The RAOs will be achieved at the completion of the remedy construction.

4. **Compliance with ARARs:** This alternative will comply with the chemical, action, and location ARARs listed in Tables 5, 6, and 7, including the Clean Water Act, Floodplain Management requirements, the Fish and Wildlife Coordination Act, and the National Historical Preservation Act.
5. **Long-Term Effectiveness and Permanence:** Alternative has a high degree of long term effectiveness and permanence because COC affected sediments are isolated for areas outside the pipeline servitude. The armored cap provides erosion protection. The long term effectiveness of the erosion control mat is high because the lightweight aggregate clay will remain in place, continuing to stabilize the sediment, population by marsh plants will effectiveness and permanence.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Alternative reduces mobility and volume of COC affected sediments. The pipe further isolates any remaining sediment.
7. **Short-Term Effectiveness:** Short term effectiveness depends upon the duration of implementation, the time it takes to sandbag and dewater the area, excavate approximately one foot of sediment, lay geotextile or a thin layer of sand, set precast concrete pipe, backfill to grade, and stabilize the canal with vegetation. Following sediment removal and 12-inch armored cap placement, the risk to benthic invertebrates from exposure to COC affected sediment is eliminated. Additionally, care will be taken to install best management practices such as silt curtains to trap any affected sediment that may become re-suspended in the water column by the excavation process. Implementation of the erosion control mat alternative provides a highly effective barrier between COC affected sediments and wave action or other erosive forces.
8. **Implementability:** Alternative has a high degree of implementability. Materials and equipment are readily available. Logistic considerations include proper timing of water diversion during preparation and pipe placement, staging requirements for backfill and equipment, and development of an erosion control plan to keep COC affected sediment out of the waterway. A hydraulic analysis will be conducted during the design to verify that the capacity of the pipe is adequate for current flow and will safely convey the design event.
9. **Cost:**

Base Implementation Cost	$353,000
Remediation and Disposal Cost	$1,285,000
Present Worth Operation & Maintenance Cost	$75,000
Estimated Total Cost	$1,713,000

Jefferson Canal Alternative 3a

1. **Technology and Process Option 3a:** 12-inch Removal/Disposal; and Containment with a 12-inch soil cap. There will be no removal or containment within the pipeline servitude.
2. **Summary:** 12-inch removal/disposal and containment with a 12-inch soil cap is applicable in the sub-areas associated with sample locations JC-2, JC-7, JC-13, JC-18, and JC-19 outside the pipeline servitude. The excavated material would be transported directly into trucks for removal from the Site. This alternative is feasible because COC affected sediments can be removed from the AOI. The pipeline servitudes will not be excavated or contained with this alternative.

3. **Overall Protection of Human Health and the Environment:** The 12-inch removal and soil cap will provide protection of the environment through the elimination of the COC-affected sediment and a disruption of the pathway between the potential receptors and the COCs to areas outside the pipeline servitude. Excavation will require the sediment to be dewatered (possibly treated) and disposed. The containment with a 12-inch soil cap will restore the canal to its pre-excavation depth and provide a new benthic habitat to the areas outside the pipeline servitude. This alternative will maintain the hydraulic capacity of the canal. This alternative does not meet the threshold criterion of overall protection of environment for 6 percent of the sub-areas to be remediated because the COC affected material in the pipeline servitude (6 percent) area is not removed or contained. The RAOs will be achieved at the completion of the remedy construction.
4. **Compliance with ARARs:** This alternative will be designed to comply with chemical, action, and location specific ARARs for areas outside the pipeline servitude. The COC-affected material remaining in the pipeline servitude (6 percent) area may not comply with ARARs for the Site.
5. **Long-Term Effectiveness and Permanence:** Alternative provides a moderately high degree of long term effectiveness and permanence because COC affected sediments are isolated for areas outside the pipeline servitude.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Alternative reduces mobility and volume of COC affected sediments. There is no reduction of toxicity, mobility, or volume for the pipeline servitude areas.
7. **Short-Term Effectiveness:** Short term effectiveness depends upon the duration of implementation. Once the sediment is removed and a 12-inch soil cap is used for stabilization of the canal, the risk to benthic invertebrates from exposure to COC affected sediment is eliminated. Additionally, care will be taken to install best management practices such as silt curtains to trap any affected sediment that may become re-suspended in the water column by the excavation process.
8. **Implementability:** Alternative has a high degree of implementability and will not require any diversion of the stream; however, it will require the removed sediment to be dewatered and transported to an appropriate disposal facility. Materials and equipment are also readily available for removal/disposal and a 12-inch soil cap.
9. **Cost:**

Base Implementation Cost	$353,000
Remediation and Disposal Cost	$811,000
Present Worth Operation & Maintenance Cost	$75,000
Estimated Total Cost	$1,239,000

Jefferson Canal Alternative 3b [Selected Alternative]

1. **Technology and Process Option 3b:** 12-inch Removal/Disposal; and Containment with a 12-inch soil cap on area outside the pipeline servitude; and a 12-inch Erosion Control Mat on the pipeline servitude.
2. **Summary:** 12-inch removal/disposal and containment with a 12-inch soil cap is applicable in the sub-areas associated with sample locations JC-2, JC-7, JC-13, JC-18, and JC-19 outside the pipeline servitude. The pipeline servitude will be contained with a 12-inch erosion control mat. The excavated material would be transported directly into trucks for removal from the Site. This alternative is feasible because COC affected sediments can be removed from the AOI.
3. **Overall Protection of Human Health and the Environment:** 12-inch removal and soil cap will provide reduction of the COC-affected sediment and a disruption of the pathway between the potential receptors and the COCs to areas outside the pipeline servitude. Excavation will require the sediment to be dewatered (possibly treated) and disposed. Containment with a 12-inch soil cap will restore the

canal to its pre-excavation depth and provide a new benthic habitat to the areas outside the pipeline servitude. The erosion control mat reduces migration of COC affected sediment by reduction of erosion, and by additionally trapping sediments and organic debris for marsh establishment. The RAOs will be achieved at the completion of the remedy construction.

4. **Compliance with ARARs:** This alternative will comply with the chemical, action, and location ARARs listed in Tables 5, 6, and 7, including the Clean Water Act, Floodplain Management requirements, the Fish and Wildlife Coordination Act, and the National Historical Preservation Act.
5. **Long-Term Effectiveness and Permanence:** Alternative provides a moderately high degree of long term effectiveness and permanence because COC affected sediments are isolated for areas outside the pipeline servitude. Additionally the lightweight aggregate clay within the erosion control mat will remain in place, continuing to stabilize the sediment; population by marsh plants will increase both effectiveness and permanence.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** This alternative does not reduce toxicity of the COC affected sediments; however, through excavation, a 12-inch soil cap, and an erosion control mat, mobility is eliminated and volume is reduced.
7. **Short-Term Effectiveness:** Short term effectiveness depends upon the duration of implementation. Once the sediment is removed and a 12-inch soil cap is used for stabilization of the canal, the risk to benthic invertebrates from exposure to COC affected sediment is eliminated. Additionally, care will be taken to install best management practices such as silt curtains to trap any affected sediment that may become re-suspended in the water column by the excavation process. Implementation of the erosion control mat alternative additionally provides a highly effective barrier between COC affected sediments and wave action or other erosive forces.
8. **Implementability:** Alternative has a high degree of implementability, and will not require any diversion of the stream; however, it will require the removed sediment to be dewatered and transported to an appropriate disposal facility. Materials and equipment are also readily available for removal/disposal and a 12-inch soil cap.
9. **Cost:**

Base Implementation Cost	$353,000
Remediation and Disposal Cost	$818,000
Present Worth Operation & Maintenance Cost	$75,000
Estimated Total Cost	$1,246,000

Jefferson Canal Alternative 3c

1. **Technology and Process Option 3c:** 12-inch Removal/Disposal; and Containment with a 12-inch Armored Cap. There will be no removal or containment within the pipeline servitude.
2. **Summary:** 12-inch removal/disposal and containment with a 12-inch armored cap is applicable in the sub-areas associated with sample locations JC-2, JC-7, JC-13, JC-18, and JC-19 outside the pipeline servitude. The excavated material would be transported directly into trucks for removal from the Site. The alternative is feasible because COC affected sediments can be removed from the AOI. The pipeline servitudes will not be excavated or contained with this alternative, so 6 percent of the AOI will not be remediated.
3. **Overall Protection of Human Health and the Environment:** 12-inch removal and an armored cap will provide reduction of the COC-affected sediment and a permanent disruption of the pathway between the potential receptors and the COCs to areas outside the pipeline servitude. Excavation will require the sediment to be dewatered (possibly treated) and disposed. Containment with a 12-inch soil cap will restore the canal to its pre-excavation depth and provide a new benthic habitat to the areas outside the pipeline servitude. The armored cap reduces migration of COC affected sediment by

reduction of erosion. This alternative does not meet the threshold criterion of overall protection of environment for 6 percent of the sub-areas to be remediated because the COC affected material in the pipeline servitude (6 percent) area is not removed or contained. The RAOs will be achieved at the completion of the remedy construction.

4. **Compliance with ARARs:** This alternative will be designed to comply with chemical, action, and location specific ARARs for areas outside the pipeline servitude. The COC-affected material remaining in the pipeline servitude (6 percent) area may not comply with ARARs for the Site.
5. **Long-Term Effectiveness and Permanence:** The long term effectiveness and permanence of this action is moderately high for 12-inch removal because this remedial action provides a permanent long term solution to exposure of COCs within the sediment for areas outside the pipeline servitude. There is a high level of long-term effectiveness for an armored cap because of the prevention and reduction of erosion.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** The removal of sediment does not reduce toxicity of the COC affected sediments, however, mobility is eliminated and volume is reduced. There is no reduction of toxicity, mobility, or volume for the pipeline servitude areas. An armor cap reduces mobility through the prevention of erosion.
7. **Short-Term Effectiveness:** Implementation of the excavation portion of the alternative provides a highly effective short term solution to contact between benthic invertebrates and the COCs. Once the sediment is removed and a 12-inch armor cap is used for stabilization of the canal, the risk to benthic invertebrates from exposure to COC affected sediment is eliminated. An armor cap's ability to reduce erosion is effective immediately after installation. Additionally, care will be taken to install best management practices such as silt curtains to trap any affected sediment that may become re-suspended in the water column by the excavation process.
8. **Implementability:** The removal/disposal and containment of the areas outside the pipeline servitude is also highly implementable and will not require any diversion of the stream; however, it will require the removed sediment to be dewatered and transported to an appropriate disposal facility. Additionally, the removed COC affected sediment must be dewatered and disposed at an authorized facility. Materials and equipment are also readily available for removal/disposal and a 12-inch armor cap.
9. **Cost:**

Base Implementation Cost	$353,000
Remediation and Disposal Cost	$1,023,000
Present Worth Operation & Maintenance Cost	$75,000
Estimated Total Cost	$1,451,000

Jefferson Canal Alternative 3d

1. **Technology and Process Option 3d:** 12-inch Removal/Disposal; and Containment with a 12-inch Armored Cap on area outside the pipeline servitude; and a 12-inch Erosion Control Mat on the pipeline servitude.
2. **Summary:** 12-inch removal/disposal and containment with a 12-inch armored cap is applicable in the sub-areas associated with sample locations JC-2, JC-7, JC-13, JC-18, and JC-19 outside the pipeline servitude. The pipeline servitude will be contained with a 12-inch erosion control mat. The excavated material would be transported directly into trucks for removal from the Site. This alternative is feasible because COC affected sediments can be removed from the AOI.
3. **Overall Protection of Human Health and the Environment:** 12-inch removal and an armored cap will provide reduction of the COC-affected sediment and a disruption of the pathway between the potential receptors and the COCs to areas outside the pipeline servitude. Excavation will require the

sediment to be dewatered (possibly treated) and disposed. Containment with a 12-inch armored cap will restore the canal to its pre-excavation depth and provide resistance to erosion. The erosion control mat reduces migration of COC affected sediment by reduction of erosion, and by additionally trapping sediments and organic debris for marsh establishment. The RAOs will be achieved at the completion of the remedy construction.

4. **Compliance with ARARs:** This alternative will comply with the chemical, action, and location ARARs listed in Tables 5, 6, and 7, including the Clean Water Act, Floodplain Management requirements, the Fish and Wildlife Coordination Act, and the National Historical Preservation Act.
5. **Long-Term Effectiveness and Permanence:** Alternative provides a high degree of long term effectiveness and permanence because COC affected sediments are isolated for areas outside the pipeline servitude. Additionally, armored cap and erosion control mat will each reduce erosion on the long term.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Alternative reduces mobility and volume of COC affected sediments. The armor cap further reduces mobility through the prevention of erosion. The erosion control mat does not reduce toxicity of the COC affected sediments, however, mobility is highly reduced.
7. **Short-Term Effectiveness:** Short term effectiveness depends upon the duration of implementation. Once the sediment is removed and a 12-inch armor cap is used for stabilization of the canal, the risk to benthic invertebrates from exposure to COC affected sediment is eliminated. The armor cap and erosion resistant mat will each reduce erosion immediately after installation. Additionally, care will be taken to install best management practices such as silt curtains to trap any affected sediment that may become re-suspended in the water column by the excavation process.
8. **Implementability:** Alternative has a high degree of implementability, and will not require any diversion of the stream; however, it will require the removed sediment to be dewatered and transported to an appropriate disposal facility. Additionally, the removed COC affected sediment must be dewatered and disposed at an authorized facility.
9. **Cost**

Base Implementation Cost	$353,000
Remediation and Disposal Cost	$1,030,000
Present Worth Operation & Maintenance Cost	$75,000
Estimated Total Cost	$1,458,000

Jefferson Canal Preferred Alternative and Rationale for Selection: Alternative 3b is selected over the other alternatives because this alternative is expected to achieve the greatest reduction of toxicity, mobility and volume. The soil cap will provide the best habitat compared to a clay or armor cap, and the Jefferson Canal areas to be capped are generally lower energy environments that do not need the additional erosion protection provided by a clay or armor cap. Alternative 3b is implementable and should achieve long-term and short-term effectiveness. Alternative numbers 1, 2a, 2c, 3a, and 3c do not meet either one or both of the threshold criteria. Of the remaining alternatives, 2b, 2d, 3b, and 3d that achieve the threshold criteria, alternative 3b has the best combination of reduction of toxicity, mobility, and volume, effectiveness, and implementability.

17.2.2 Jefferson Canal Spoil Pile Comparative Analysis

Jefferson Canal Spoil Pile Alternative 1

1. **Technology and Process Option:** No Action.

2. **Summary:** No remedial action taken; therefore no reduction of exposure between benthic invertebrates and COCs.
3. **Overall Protection of Human Health and the Environment:** Alternative would not provide protection to potential receptors from COC affected soils.
4. **Compliance with ARARs:** Not compliant because no remedial action has been taken.
5. **Long-Term Effectiveness and Permanence:** Alternative would provide a low level of long-term effectiveness and permanence because it would not result in any significant change in the risks associated with COC affected sediment.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Alternative would provide a low level of long-term effectiveness and permanence because it would not result in any significant change in the risks associated with COC affected soils.
7. **Short-Term Effectiveness:** The short-term effectiveness of this alternative is not applicable since no actions are taken.
8. **Implementability:** Not applicable since no actions are taken. No delineation of the buried pipeline servitude will be required.
9. **Cost:** $0

Jefferson Canal Spoil Pile Alternative 2a

1. **Technology and Process Option:** Containment with a 2-foot Composite Cap.
2. **Summary:** Feasible because cap would isolate COC affected soils from potential receptors and prevent infiltration from rainwater and erosion from surface runoff.
3. **Overall Protection of Human Health and the Environment:** Alternative provides protection through isolation of the COC affected soils from the environment and potential receptors. The RAOs will be achieved at the completion of the remedy construction.
4. **Compliance with ARARs:** This alternative will comply with the chemical, action, and location ARARs listed in Tables 5, 6, and 7, including the Clean Water Act, Floodplain Management requirements, the Fish and Wildlife Coordination Act, and the National Historical Preservation Act.
5. **Long-Term Effectiveness and Permanence:** Alternative would provide a high level of long-term effectiveness and permanence because the estimated breakthrough of organic COCs is on the order of hundreds of years. The cap will be anchored and stabilized.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Alternative provides no reduction in toxicity or volume. Mobility would be reduced.
7. **Short-Term Effectiveness:** The short-term effectiveness of this alternative is moderate to high due to construction duration associated with cap installation. Isolation from COCs is effective immediately.
8. **Implementability:** The implementability for this alternative is moderate due to the possibility of interference with the buried pipelines. Implementability is reduced by the pipeline servitude which requires the cap to be installed in pieces. Implementability of installing a cap on the pipeline servitude will be determined in the Remedial Design phase.
9. **Cost:**

Base Implementation Cost	$515,000
Remediation and Disposal Cost	$1,538,000
Present Worth Operation & Maintenance Cost	$88,000
Estimated Total Cost	$2,141,000

Jefferson Canal Spoil Pile Alternative 2b [Selected Alternative]

1. **Technology and Process Option:** Removal/disposal of mounds to grade and containment with a 2-foot Composite Cap over the entire area.
2. **Summary:** This alternative includes the removal of the mounds to grade with a 2-foot composite cap over the entire Jefferson Canal Spoil Pile. The composite cap will consist of 12-inches of topsoil and 12-inches of clay.
3. **Overall Protection of Human Health and the Environment:** Alternative provides protection of the environment through isolation and removal of COC affected soil. The small insects and animals at the Site generally burrow less than 2-feet below the ground surface and the cap will minimize their access. The RAOs will be achieved at the completion of the remedy construction.
4. **Compliance with ARARs:** This alternative will comply with the chemical, action, and location ARARs listed in Tables 5, 6, and 7, including the Clean Water Act, Floodplain Management requirements, the Fish and Wildlife Coordination Act, and the National Historical Preservation Act.
5. **Long-Term Effectiveness and Permanence:** Alternative would provide a high level of long-term effectiveness and permanence because COC affected soil is removed from the site and the composite cap provides long term isolation of COCs. The cap will be anchored and stabilized.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Reduction of toxicity and volume is high within the excavated areas. The reduction of mobility is high because of installation of the cap.
7. **Short-Term Effectiveness:** The short-term effectiveness of this alternative is moderate due to construction duration associated with soil removal. Removal of COCs is effective immediately.
8. **Implementability:** This alternative is feasible because the area is accessible for removal/disposal of the mounds to grade and for the installation of composite cap materials. However, the implementability is moderate due to the possibility of interference with the buried pipelines. The portion of the mound within the pipeline area will be removed with light equipment if it is determined during the Remedial Design that it can be done without compromising the integrity of the pipelines. Also, the Jefferson Canal Spoil Piles area contributes to the hydraulic and storage capacity of the storm water drainage system for the area. The removal of the spoil piles will increase these capacities, while installation of the cap would reduce them. Any construction that resulted in a net reduction of the hydraulic or storage capacity would not be acceptable. The design may require some modification depending on the findings of the Remedial Design so the remedy construction does not adversely impact the drainage system.
9. **Cost:**

Base Implementation Cost	$515,000
Remediation and Disposal Cost	$1,775,000
Present Worth Operation & Maintenance Cost	$88,000
Estimated Total Cost	$2,378,000

Jefferson Canal Spoil Pile Alternative 2c

1. **Technology and Process Option:** Partial Containment with a 2-foot Composite Cap.
2. **Summary:** Feasible because cap would isolate COC affected soils outside of the pipeline servitude from potential receptors and prevent infiltration from rainwater and erosion from surface runoff.
3. **Overall Protection of Human Health and the Environment:** Alternative provides protection of the environment through isolation from COC affected soil for the areas outside of the pipeline servitude. This alternative does not meet the threshold criterion of overall protection of environment for 24 percent of the sub-areas to be remediated because the COC- affected material in the pipeline servitude (24 percent) area is not removed or contained. The RAOs will not be achieved in the pipeline servitude areas.

4. **Compliance with ARARs:** This alternative will be designed to comply with chemical, location, and action specific ARARs applicable and relevant for the Site for areas outside the pipeline servitude. The COC affected material remaining in the pipeline servitude (24 percent) area may not comply with ARARs for the site.
5. **Long-Term Effectiveness and Permanence:** Alternative would provide a high level of long-term effectiveness and permanence for the areas outside of the pipeline servitude. The cap will be anchored and stabilized.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Alternative provides no reduction in toxicity or volume. Mobility would be reduced for the areas outside of the pipeline servitude.
7. **Short-Term Effectiveness:** The short-term effectiveness of this alternative, for areas outside of the pipeline servitude, is moderate to high due to construction duration associated with cap installation. Isolation from COCs is effective immediately.
8. **Implementability:** The implementability of this alternative is high, based on technical feasibility, and availability of services and materials. No COC affected soil will be excavated so there is no excavation, transportation, or disposal of soil for this alternative. The pipeline servitude will need to be delineated during the Remedial Design phase.
9. **Cost:**

Base Implementation Cost	$515,000
Remediation and Disposal Cost	$1,211,000
Present worth Operation & Maintenance Cost	$88,000
Estimated Total Cost	$1,814,000

Jefferson Canal Spoil Pile Alternative 3a

1. **Technology and Process Option:** 12-inch removal/disposal, removal/disposal of mounds to grade, and containment with a 2-foot Composite Cap.
2. **Summary:** Feasible because the area is accessible for excavation/disposal of 12-inches of COC affected soils and for the installation of composite cap materials.
3. **Overall Protection of Human Health and the Environment:** Alternative provides protection of the environment through isolation and removal of COC affected soil. The RAOs will be achieved at the completion of the remedy construction.
4. **Compliance with ARARs:** This alternative will comply with the chemical, action, and location ARARs listed in Tables 5, 6, and 7, including the Clean Water Act, Floodplain Management requirements, the Fish and Wildlife Coordination Act, and the National Historical Preservation Act.
5. **Long-Term Effectiveness and Permanence:** Alternative would provide a high level of long-term effectiveness and permanence because COC affected soil is removed from the site and the composite cap provides long term isolation of COCs. The cap will be anchored and stabilized.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Reduction of toxicity and volume is high within the excavated areas. The reduction of mobility is high because of installation of cap.
7. **Short-Term Effectiveness:** The short-term effectiveness of this alternative is moderate due to construction duration associated with soil removal. Removal of COCs is effective immediately.
8. **Implementability:** The implementability for this alternative is moderate due to the possibility of interference with the buried pipelines. Implementability is reduced by the pipeline servitude which requires the cap to be installed in pieces. Implementability of installing a cap on the pipeline servitude will be determined in the Remedial Design phase.
9. **Cost:**

Base Implementation Cost	$555,000
Remediation and Disposal Cost	$3,456,000

Present Worth Operation & Maintenance Cost	$88,000
Estimated Total Cost	$4,099,000

Jefferson Canal Spoil Pile Alternative 3b

1. **Technology and Process Option:** 12-inch removal/disposal, removal/disposal of mounds to grade, and partial containment with a 2-foot Composite Cap.
2. **Summary:** Feasible because the area is accessible for excavation/disposal of 12-inches of COC affected soils outside of the buried pipeline servitude and for the installation of composite cap materials also outside of the servitude.
3. **Overall Protection of Human Health and the Environment:** Alternative provides protection of the environment through isolation and removal of COC affected soil outside of the buried pipeline servitude. This alternative does not meet the threshold criterion of overall protection of environment for 24 percent of the sub-areas to be remediated because the COC- affected material in the pipeline servitude (24 percent) area is not removed or contained. The RAOs will not be achieved in the pipeline servitude area.
4. **Compliance with ARARs:** This alternative will be designed to comply with chemical, location, and action specific ARARs applicable and relevant for the Site for areas outside the pipeline servitude. The COC affected material remaining in the pipeline servitude (24 percent) area may not comply with ARARs for the site.
5. **Long-Term Effectiveness and Permanence:** Alternative would provide a high level of long-term effectiveness and permanence outside of buried pipeline servitude because COC affected soil is removed from the site and the composite cap provides long term isolation of COCs. The cap will be anchored and stabilized.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Reduction of toxicity and volume is high within the excavated areas. The reduction of mobility is high because of installation of cap for all areas outside of the buried pipeline servitude.
7. **Short-Term Effectiveness:** The short-term effectiveness of this alternative is moderate, for all areas outside of the buried pipeline servitude, due to construction duration associated with soil removal and isolation of COCs from installation of cap.
8. **Implementability:** The implementability for this alternative is moderate to high based on technical feasibility and availability of materials for installation of cap. The pipeline servitude will need to be delineated during the Remedial Design phase.
9. **Cost:**

Base Implementation Cost	$555,000
Remediation and Disposal Cost	$3,158,000
Present Worth Operation & Maintenance Cost	$88,000
Estimated Total Cost	$3,801,000

Jefferson Canal Spoil Pile Preferred Alternative and Rational for Alternative Selection:

Alternative 2b is selected over the other alternatives because this alternative will achieve the key RAO goal of protecting upper trophic level receptors. The composite cap will provide the improved habit of a soil cap and still provide erosion protection and isolation with the clay portion of the cap. This alternative achieves risk reduction by combining removal and containment of the spoil pile soil. Alternative numbers 1, 2c, and 3b do not meet either one or both of the threshold criteria. Of the

remaining alternatives 2a, 2b, and 3a that achieve the threshold criteria, Alternative 2b has good long term effectiveness and reduction of toxicity, mobility, and volume, and lower cost than alternative 3a.

17.2.3 Former Star Lake Comparative Analysis

Former Star Lake Alternative 1

1. **Technology and Process Option:** No Action.
2. **Summary:** No remedial action taken; therefore no reduction of exposure between benthic invertebrates and COCs.
3. **Overall Protection of Human Health and the Environment:** Alternative would not provide protection to potential receptors from COC affected sediments.
4. **Compliance with ARARs:** Not compliant because no remedial action has been taken.
5. **Long-Term Effectiveness and Permanence:** Alternative would provide a low level of long-term effectiveness and permanence because it would not result in any significant change in the risks associated with COC affected sediment.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** This alternative provides no reduction in toxicity, volume, or mobility of COCs.
7. **Short-Term Effectiveness**: The short-term effectiveness of this alternative is not applicable since no actions are taken.
8. **Implementability:** Not applicable since no actions are taken.
9. **Cost:** $0

Former Star Lake Alternative 2a

1. **Technology and Process Option:** 12-inch removal/disposal and containment with a 12-inch Clay Cap.
2. **Summary:** Removal/disposal and a 12-inch clay cap for sub-areas SL-6, SL-7, SL-9, and SL-10 are applicable to areas outside the pipeline servitude. The COC affected sediment will be partially removed from Site and disposed in an appropriate offsite waste facility. For Alternative 2a, the servitude will not be excavated or capped.
3. **Overall Protection of Human Health and the Environment:** Alternative provides a permanent disruption of the pathway between receptors and the COC effected sediment. Cap installation will restore the bottom of the Former Star Lake AOI to the pre-excavation depth. A clay cap provides a barrier between the benthic invertebrates and COC affected sediment, and resists erosion from an inundated drainage canal. Neither the hydraulic capacity nor the sediment topography of the canal will be modified by the cap design. This alternative does not meet the threshold criterion of overall protection of environment for 13 percent of the sub-areas to be remediated because the COC affected material in the pipeline servitude (13 percent) area is not removed or contained. The RAOs will not be achieved in the pipeline servitude areas.
4. **Compliance with ARARs:** This alternative will be designed to comply with chemical, location, and action specific ARARs for the Site for areas outside the pipeline servitude. The COC affected material remaining in the pipeline servitude (13 percent) area may not comply with ARARs for the Site.
5. **Long-Term Effectiveness and Permanence:** Alternative provides a moderately high level of long-term effectiveness and permanence. For all areas outside of the pipeline servitude, the COCs will be isolated from the potential receptors and the area will be stabilized. Infiltration from rain events, erosion, and benthic invertebrate burrowing will be prevented by the cap and established vegetation.

6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Alternative reduces volume and eliminates mobility of COC affected sediment. Reduction of toxicity is dependent on ratio of soil removed and components of the clay cap. For Alternative 2a, the servitude will not be excavated or capped.
7. **Short-Term Effectiveness:** Alternative provides short term effectiveness for the protection of ecological receptors in correspondence to duration of implementation, and reduces risks associated with exposure to COCs for all areas outside of the pipeline servitude.
8. **Implementability:** Alternative is moderately to highly implementable. Materials and equipment are readily available. Implementability is reduced by the pipeline servitude, which will require the implementation area to be divided into multiple subsections, thus increasing fencing, staking, and other administrative controls.
9. **Cost:**

Base Implementation Cost	$362,000
Remediation and Disposal Cost	$4,665,000
Present Worth Operation & Maintenance Cost	$149,000
Estimated Total Cost	$5,176,000

Former Star Lake Alternative 2b [Selected Alternative]

1. **Technology and Process Option:** 12-inch removal/disposal, and containment with a 12-inch clay cap for sub-areas SL-6, SL-7, SL-9, and SL-10 on the area outside pipeline servitude. Inside the pipeline servitude, a 12-inch Erosion Control Mat or a 12-inch composite cap will be placed depending on whether the area is on the banks of the Star Lake Canal.
2. **Summary:** The 12-inch removal/disposal and containment with a 12-inch clay cap is applicable to areas outside the pipeline servitude. The removal/disposal will not be done within 25-feet of the pipelines. Containment with a 12-inch Erosion Control Mat is applicable to the pipeline servitude areas near the bank of the Star Lake Canal and a 12-inch Composite Cap is applicable to pipeline servitude areas not near the banks of the Star Lake Canal. All removed sediment will be de-watered and properly disposed off-site.
3. **Overall Protection of Human Health and the Environment:** Alternative will restore the area to its pre-excavation depth, provide a new benthic habitat, provide a barrier between the benthic invertebrates and COC affected sediment, and resist erosion from an inundated drainage canal. Within the servitude, an erosion control mat will protect the environment by partially inhibiting the migration of sediment by reduction of erosion, and by trapping sediments and organic debris for marsh establishment. The lightweight aggregate of the mat will allow it to lie atop existing sediment without sinking, highly reducing disruption. The RAOs will be achieved at the completion of the remedy construction.
4. **Compliance with ARARs:** This alternative will comply with the chemical, action, and location ARARs listed in Tables 5, 6, and 7, including the Clean Water Act, Floodplain Management requirements, the Fish and Wildlife Coordination Act, and the National Historical Preservation Act.
5. **Long-Term Effectiveness and Permanence:** Alternative provides a high level of long term effectiveness and permanence. For all areas outside of the pipeline servitude, COCs within the sediment will be isolated and stabilized. The lightweight aggregate clay of the erosion control mat will remain in place and population by marsh plants will increase both effectiveness and permanence.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Alternative reduces mobility and volume of COC affected sediments. Reduction of toxicity is dependent on ratio of soil removed. The clay cap will further isolate any remaining affected sediment, and reduce erosion.

7. **Short-Term Effectiveness:** Alternative provides short term effectiveness in correspondence with the duration of implementation, which consists of time for excavation, clay cap placement, and placement of the erosion control mat. Sediment erosion is immediately reduced, in a level or inclined setting; implementation causes only minimal disruption or re-suspension of sediments.
8. **Implementability:** Alternative is moderately implementable. Materials and equipment are readily available. The removed COC affected sediment must be dewatered and disposed at an authorized facility. Logistical considerations are few, including transportation of materials, and coordination of site access; no heavy equipment diversion of water, or dewatering of sediment is necessary. Implementability is reduced by the pipeline servitude which requires the cap to be installed in pieces. Implementability of work in pipeline servitude will be further evaluated in the Remedial Design phase.
9. **Cost:**

Base Implementation Cost	$362,000
Remediation and Disposal Cost	$4,691,000
Present Worth Operation & Maintenance Cost	$149,000
Estimated Total Cost	$5,202,000

Former Star Lake Alternative 3a

1. **Technology and Process Option:** 12-inch removal/disposal and containment with a 12-inch Composite Cap.
2. **Summary:** The removal/disposal and a 12-inch composite cap for sub-areas SL-6, SL-7, SL-9, and SL-10 are applicable to areas outside the pipeline servitude. For Alternative 3a, the servitude will not be excavated or capped.
3. **Overall Protection of Human Health and the Environment:** Alternative provides permanent disruption of the pathway between receptors and the COC affected sediment. The sediment will be partially removed from Site and disposed in an appropriate off Site waste facility. A cap with 6 inches of clay and 6 inches of topsoil will be anchored and stabilized to replace excavated soil outside of the pipeline servitude. This alternative will be designed not to modify the hydraulic capacity of the Former Star Lake AOI. This alternative does not meet the threshold criterion of overall protection of environment for 13 percent of the sub-areas to be remediated because the COC affected material in the pipeline servitude (13 percent) area is not removed or contained. The RAOs will not be achieved in the pipeline servitude areas.
4. **Compliance with ARARs:** This alternative will be designed to comply with chemical, location, and action specific ARARs for the Site for areas outside the pipeline servitude. The COC affected material remaining in the pipeline servitude (13 percent) area may not comply with ARARs for the Site.
5. **Long-Term Effectiveness and Permanence:** Alternative provides a moderate level of long term effectiveness and permanence. For all areas outside of the pipeline servitude, the COCs will be isolated from the receptors and the area will be stabilized. Bioturbation from benthic invertebrate burrowing and erosion from water movement will be reduced by the composite cap.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Alternative reduces volume and mobility of COC affected sediment. Reduction of toxicity is dependent on ratio of soil removed and components of the composite cap. For Alternative 3a, the servitude will not be excavated or capped.
7. **Short-Term Effectiveness:** Alternative provides short term effectiveness in correspondence with the duration of implementation, which consists of time for the 12-inch removal/disposal and placement of a 12-inch containment cap in all areas outside of the pipeline servitude.
8. **Implementability:** Alternative is moderately to highly implementable. Materials and equipment are readily available. Implementability is reduced by the pipeline servitude, which will require the

implementation area to be divided into multiple subsections, thus increasing fencing, staking, and other administrative controls.

9. **Cost:**

Base Implementation Cost	$362,000
Remediation and Disposal Cost	$4,868,000
Present Worth Operation & Maintenance Cost	$149,000
Estimated Total Cost	$5,379,000

Former Star Lake Alternative 3b

1. **Technology and Process Option:** 12-inch removal/disposal and containment with a 12-inch Composite Cap on area outside pipeline servitude, and a 12-inch Erosion Control Mat and 12-inch Composite Cap on the pipeline servitude
2. **Summary:** The removal/disposal and containment with a 12-inch Composite Cap for sub-areas SL-6, SL-7, SL-9, and SL-10 are applicable to areas outside the pipeline servitude. Containment with a 12-inch Erosion Control Mat is applicable to the pipeline servitude areas near the bank of the Star Lake Canal and a 12-inch Composite Cap is applicable to pipeline servitude areas not near the banks of the Star Lake Canal.
3. **Overall Protection of Human Health and the Environment:** Alternative provides a disruption of the pathway between the potential receptors and the COCs for areas outside the pipeline servitude. An erosion control mat will partially inhibit the migration of sediment by reduction of erosion, and by additionally trapping sediments and organic debris for marsh establishment. The lightweight aggregate allows the mat to lie atop existing sediment without sinking, highly reducing disruption. The RAOs will be achieved at the completion of the remedy construction.
4. **Compliance with ARARs:** This alternative will comply with the chemical, action, and location ARARs listed in Tables 5, 6, and 7, including the Clean Water Act, Floodplain Management requirements, the Fish and Wildlife Coordination Act, and the National Historical Preservation Act.
5. **Long-Term Effectiveness and Permanence:** Alternative provides a high level of long term effectiveness and permanence for all areas outside of the pipeline servitude. The lightweight aggregate clay of the erosion control mat will remain in place and population by marsh plants will increase both effectiveness and permanence.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Alternative reduces volume and mobility of COC affected sediments. Reduction of toxicity is dependent on ratio of soil removed and components of the composite cap.
7. **Short-Term Effectiveness:** Alternative provides a highly effective barrier between COC affected sediments and wave action or other erosive forces. The mat provides immediate reduction of sediment erosion in a level or inclined setting. Additionally, implementation causes only minimal disruption or re-suspension of sediments.
8. **Implementability:** Alternative is moderately implementable in the areas outside the pipeline servitude. Materials and equipment are readily available. The removed COC affected sediment must be dewatered and disposed at an authorized facility. The erosion control mat has a high degree of implementability, because materials are readily available and easily installed. Logistical considerations are few, including transportation of materials, and coordination of site access; no heavy equipment diversion of water, or dewatering of sediment is necessary. Implementability is reduced by the pipeline servitude which requires the cap to be installed in pieces. Implementability of work in pipeline servitude will be further evaluated in the Remedial Design phase.
9. **Cost:**

Base Implementation Cost	$362,000

Remediation and Disposal Cost	$4,894,000
Present Worth Operation & Maintenance Cost	$149,000
Estimated Total Cost	$5,405,000

Former Star Lake Preferred Alternative and Rational for Alternative Selection: Alternative 2b is selected over the other alternatives because this alternative is expected to achieve the greatest reduction of toxicity, mobility and volume. It is implementable and should achieve long-term and short-term effectiveness. Alternative numbers 1, 2a, and 3a do not meet either one or both of the threshold criteria. Of the remaining alternatives 2b and 3b that achieve the threshold criteria, Alternative 2b has the best combination of reduction of toxicity, mobility, and volume, and long term effectiveness. Alternative 3b is rated the same as alternative 2b in all balancing criteria, and includes the same remedy components as alternative 2b except that 3b has a composite cap in the pipeline servitude areas instead of an clay cap included in alternative 2b. A clay cap will provide better isolation of the underlying contaminated material and erosion protection. The erosion control mat will provide additional erosion protection on the banks of the Star Lake Canal where to erosion forces will be greater. Alternative 2b was selected to provide better isolation in the pipeline servitude areas.

17.2.4 Star Lake Canal Comparative Analysis

Star Lake Canal Alternative 1

1. **Technology and Process Option:** No Action.
2. **Summary:** No remedial action taken; therefore no reduction of exposure between benthic invertebrates and COCs.
3. **Overall Protection of Human Health and the Environment:** Alternative would not provide protection to potential receptors from COC affected sediments.
4. **Compliance with ARARs:** Not compliant because no remedial action has been taken.
5. **Long-Term Effectiveness and Permanence:** Alternative would provide a low level of long-term effectiveness and permanence because it would not result in any significant change in the risks associated with COC affected sediment.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** This alternative provides no reduction in toxicity, volume, or mobility of COCs.
7. **Short-Term Effectiveness:** The short-term effectiveness of this alternative is not applicable since no actions are taken.
8. **Implementability:** Not applicable since no actions are taken.
9. **Cost:** $0

Star Lake Canal Alternative 2 [Selected Alternative]

1. **Technology and Process Option:** 12-inch removal/disposal and containment with a 12-inch Clay Cap.
2. **Summary:** Feasible option for sub-areas corresponding to sample numbers SLC-11 and SLC-6. Hydraulic excavation is the preferred removal technology. If sediment removal is determined to not be feasible during the Remedial Design, then a 12-inch clay cap will be installed on the pipeline servitude. However, the hydraulic capacity of the canal must also be maintained, so any cap will be designed so that the hydraulic capacity of the canal is not reduced.
3. **Overall Protection of Human Health and the Environment:** This alternative provides protection of the environment through removal of the COC affected sediment. The pathway between benthic

invertebrates and COCs is disrupted. The clay cap provides resistance to erosion and burrowing, and provides better isolation of the underlying chemicals than an armored cap. The RAOs will be achieved at the completion of the remedy construction.

4. **Compliance with ARARs:** This alternative will comply with the chemical, action, and location ARARs listed in Tables 5, 6, and 7, including the Clean Water Act, Floodplain Management requirements, the Fish and Wildlife Coordination Act, and the National Historical Preservation Act.
5. **Long-Term Effectiveness and Permanence:** Provides a high level of long-term effectiveness and permanence. Pathway between benthic invertebrates and COCs is permanently disrupted. Bioturbation from benthic invertebrate burrowing is eliminated.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** No reduction of toxicity is achieved, however volume is reduced and mobility eliminated.
7. **Short-Term Effectiveness:** The short-term effectiveness of this alternative is moderate due to construction duration associated with cap installation.
8. **Implementability:** Implementability of this alternative is moderately high. Standard excavation equipment and materials are readily available. Excavated sediment will require dewatering and disposal. Sediment and erosion controls will need to be in place to prevent any COC affected sediments from becoming re-suspended and entering the waterway. The hydraulic capacity of this canal will be maintained at pre-excavation conditions and a Section 10 permit will be required for working in a navigable waterway.
9. **Cost:**

Base Implementation Cost	$350,000
Remediation and Disposal Cost	$3,803,000
Present Worth Operation & Maintenance Cost	$149,000
Estimated Total Cost	$4,302,000

Star Lake Canal Alternative 3

1. **Technology and Process Option:** 12-inch removal/disposal and containment with a 12-inch Armored Cap.
2. **Summary:** Feasible option for sub-areas corresponding to sample numbers SLC - 11 and SLC -6.
3. **Overall Protection of Human Health and the Environment:** Alternative provides protection of the environment through removal of the COC affected sediment. Pathway between benthic invertebrates and COCs is disrupted. Armored cap provides resistance from erosion and some resistance to burrowing. Armored Cap does not provide a permanent barrier between benthic invertebrates and COC affected sediments. The RAOs will be achieved at the completion of the remedy construction.
4. **Compliance with ARARs:** This alternative will comply with the chemical, action, and location ARARs listed in Tables 5, 6, and 7, including the Clean Water Act, Floodplain Management requirements, the Fish and Wildlife Coordination Act, and the National Historical Preservation Act.
5. **Long-Term Effectiveness and Permanence:** A moderately high level of effectiveness and permanence. Pathway between COC affected sediment and benthic invertebrates will be disrupted. The armored cap provides resistance to erosion and some resistance to benthic burrowing.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** No reduction of toxicity is achieved, however volume is reduced and mobility is continually inhibited.
7. **Short-Term Effectiveness:** The short-term effectiveness of this alternative is moderate to high because construction duration is not as long as the composite cap installation. Removal of COCs is effective immediately, though the water column may carry COC affected sediments.
8. **Implementability:** Implementability of this alternative is moderately high. Standard excavation equipment and materials are readily available. Excavated sediment will require dewatering and

disposal. Sediment and erosion controls will need to be in place to prevent any COC affected sediments from becoming re-suspended and entering the waterway. The hydraulic capacity of this canal will be maintained at the pre-excavation level. A Section 10 permit will be required for working in a navigable waterway. Implementability of work within the pipeline servitude will be further determined in the Remedial Design.

9. **Cost:**

Base Implementation Cost	$350,000
Remediation and Disposal Cost	$4,656,000
Present Worth Operation & Maintenance Cost	$149,000
Estimated Total Cost	$5,155,000

Star Lake Canal Preferred Alternative and Rational for Alternative Selection: Alternative 2 is selected over the other alternatives because this alternative is expected to achieve the greatest reduction of toxicity, mobility and volume. The clay cap will provide additional erosion protection compared to a soil cap, but because the Star Lake Canal is somewhat deeper in the areas to be remediated, the additional protection from boat wakes provided by an armor cap is not needed. It is implementable and should achieve long-term and short-term effectiveness. Removal of material over the pipeline servitude areas will be determined during the Remedial Design phase and if removal is not possible, the 12-inch clay Cap or erosion control mat will be installed on the pipeline servitude, and removal/disposal will be implemented. Alternative number 1 does not meet either of the threshold criteria. Of the remaining alternatives 2 and 3 that achieve the threshold criteria, Alternative 2 has the best combination of reduction of toxicity, mobility, and volume, short term effectiveness, and long term effectiveness.

17.2.5 Gulf States Utility Canal Comparative Analysis

Gulf States Utility Canal Alternative 1

1. **Technology and Process Option:** No Action.
2. **Summary:** Not feasible because sediments pose an unacceptable risk to the benthic community.
3. **Overall Protection of Human Health and the Environment:** Would not provide protection of benthic invertebrates and the environment.
4. **Compliance with ARARs:** Not compliant because no remedial action has been taken.
5. **Long-Term Effectiveness and Permanence:** Low level of long-term effectiveness and permanence because it would not result in any significant change in the risks associated with COC affected sediment.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Reduction of toxicity is low because this alternative does not involve a treatment technology that reduces the presence of COCs.
7. **Short-Term Effectiveness:** The short-term effectiveness of this alternative is not applicable since no actions are taken.
8. **Implementability:** Not applicable since no actions are taken.
9. **Cost:** $0

Gulf States Utility Canal Alternative 2 [Selected Alternative]

1. **Technology and Process Option:** Containment with a 12-Inch Composite Cap.
2. **Summary:** Technology isolates COCs from the benthic environment on a long- and short-term basis. Typical estimated breakthrough of organic COCs is on the order of hundreds of years. A composite

cap can be implemented using commercially available equipment and operators, and will be designed to not alter the hydraulic capacity of the canal. This alternative does not have an excavation component. This alternative will be implemented for the Gulf State Utility Canal polygon that corresponds to sample number GSUC-7. Erosion control matting will be used to stabilize the canal embankment.

3. **Overall Protection of Human Health and the Environment:** Provides protection of benthic invertebrates and the environment through (1) isolation of COCs, (2) control of risk to benthic health by eliminating contact with COCs, and (3) provision of an unaffected benthic habitat. The RAOs will be achieved at the completion of the remedy construction.
4. **Compliance with ARARs:** This alternative will comply with the chemical, action, and location ARARs listed in Tables 5, 6, and 7, including the Clean Water Act, Floodplain Management requirements, the Fish and Wildlife Coordination Act, and the National Historical Preservation Act.
5. **Long-Term Effectiveness and Permanence:** High level of long-term effectiveness and permanence because the estimated breakthrough of organic COCs is on the order of hundreds of years. Composite cap will be designed to have high resistance to erosion.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Reduces mobility by providing a barrier between the constituent affected sediment and the environment. This alternative does not reduce toxicity or volume.
7. **Short-Term Effectiveness:** Short term effectiveness of the composite cap depends upon duration of implementation. This includes time for standard construction mobilization and staging of equipment, cap material placement, and stabilization of the area following cap installation.
8. **Implementability:** Moderately high level of implementability within the Gulf States Utility Canal. Materials, equipment, and technology are readily available. Timing is not critical because the canal is not continually inundated, and does not require any water diversion. The cap will serve to anchor the sediment, and erosion control matting will stabilize the embankment. Based on available information, there are no pipeline crossings in the area to be remediated. However, the location and depth of pipelines will be further determined in the Remedial Design phase.
9. **Cost:**

Base Implementation Cost	$336,000
Remediation and Disposal Cost	$174,000
Present Worth Operation & Maintenance Cost	$149,000
Estimated Total Cost	$659,000

Gulf States Utility Canal Alternative 3

1. **Technology and Process Option:** 12-inch removal/disposal and containment with a 12-inch Armored Cap.
2. **Summary:** Technology permanently removes COC affected sediments from the benthic environment. Excavation and capping utilizes standard equipment, and will require significant advanced coordination. Armored cap will replace removed sediment, and be designed not to alter the hydraulic capacity of the canal.
3. **Overall Protection of Human Health and the Environment:** Provides protection of benthic invertebrates and the environment through permanent removal of COC affected sediment and creation of a new benthic habitat. The RAOs will be achieved at the completion of the remedy construction.
4. **Compliance with ARARs:** This alternative will comply with the chemical, action, and location ARARs listed in Tables 5, 6, and 7, including the Clean Water Act, Floodplain Management requirements, the Fish and Wildlife Coordination Act, and the National Historical Preservation Act.

5. **Long-Term Effectiveness and Permanence:** High level of long-term effectiveness and permanence through removal of COC affected sediment and new erosion resistant benthic habitat.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Reduces volume and mobility of COC affected sediment because affected sediment is removed from the site, and no longer has the ability to migrate to water or other sediment.
7. **Short-Term Effectiveness:** Short-term effectiveness of this alternative depends upon construction duration associated with sediment removal and armored cap placement. Removal of COCs is effective immediately, though the water column may carry COC affected sediments.
8. **Implementability:** This alternative has moderate implementability within the Gulf States Utility Canal. Materials, equipment and technology are readily available. Timing is not critical because the canal is infrequently inundated with water and does not require water diversion. Removed sediment will be dewatered in a controlled manor and removed to an appropriate facility for permanent disposal. Implementability of work within or near the pipeline servitude will be further determined in the Remedial Design phase.
9. **Cost:**

Base Implementation Cost	$339,000
Remediation and Disposal Cost	$735,000
Present Worth Operation & Maintenance Cost	$149,000
Estimated Total Cost	$1,223,000

Gulf States Utility Canal Alternative 4

1. **Technology and Process Option:** 12-inch removal/disposal.
2. **Summary:** Excavation removes COC affected sediments from the benthic environment. Excavation utilizes standard equipment, and will require significant advanced coordination.
3. **Overall Protection of Human Health and the Environment:** Provides protection of benthic invertebrates and the environment through permanent removal of COC affected sediment. The RAOs will be achieved at the completion of the remedy construction.
4. **Compliance with ARARs:** This alternative will comply with the chemical, action, and location ARARs listed in Tables 5, 6, and 7, including the Clean Water Act, Floodplain Management requirements, the Fish and Wildlife Coordination Act, and the National Historical Preservation Act.
5. **Long-Term Effectiveness and Permanence:** High level of long-term effectiveness and permanence through removal of COC affected sediment.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Reduces volume and mobility of COC affected sediment because affected sediment is removed from the site, and no longer has the ability to migrate to water or other sediment.
7. **Short-Term Effectiveness:** Short-term effectiveness of this alternative depends upon construction duration associated with sediment removal. Removal of COCs is effective immediately, though the water column may carry COC-affected sediments.
8. **Implementability:** Moderate level of implementability within the Gulf States Utility Canal. Materials, equipment and technology are readily available. Timing is not critical because the canal is infrequently inundated with water and does not require water diversion. Removed sediment will be dewatered in a controlled manner and removed to an appropriate facility for permanent disposal. Implementability of work within or near the pipeline servitude will be further determined in the Remedial Design phase.
9. **Cost:**

Base Implementation Cost	$339,000
Remediation and Disposal Cost	$483,000

Present Worth Operation & Maintenance Cost	$149,000
Estimated Total Cost	$971,000

Gulf States Utility Canal Preferred Alternative and Rational for Alternative Selection: Alternative 2 is selected over the other alternatives because this alternative will achieve risk reduction by installation of a 12-inch composite cap to prevent erosion (the clay portion of the cap) of the soft canal bottom and will provide a new benthic habitat (the soil portion of the cap). The long-term effectiveness and permanence of a composite cap is high. The migration of COCs caused by erosion and bioturbation from the burrowing of benthic invertebrates will be continually inhibited.

This alternative does not reduce toxicity or volume; however, the composite cap reduces the mobility of the constituents by providing a barrier between the affected sediment and the environment. The containment alternative is moderately to highly implementable. Materials, equipment, and technology are readily available. Timing is not critical because the canal is not continually inundated, and does not require any water diversion. The cap will serve to anchor the sediment, and erosion control matting will stabilize the embankment.

Alternative number 1 does not achieve either of the threshold criteria. Of the remaining alternatives 2, 3, and 4 that achieve the threshold criteria, Alternative 2 has the best combination of reduction of toxicity, mobility, and volume, short term effectiveness, implementability, and long term effectiveness. Alternative 3 did rate slightly higher on long term effectiveness and reduction of toxicity, mobility, and volume, but it also rated slightly lower in terms of implementability and short term effectiveness.

17.2.6 Molasses Bayou Waterway Comparative Analysis

Molasses Bayou Waterway Alternative 1

1. **Technology and Process Option:** No Action.
2. **Summary:** Not feasible because sediments pose an unacceptable risk to the benthic community.
3. **Overall Protection of Human Health and the Environment:** Would not provide protection of benthic invertebrates and the environment.
4. **Compliance with ARARs:** Not compliant because no remedial action has been taken.
5. **Long-Term Effectiveness and Permanence:** Low level of long-term effectiveness and permanence because it would not result in any significant change in the risks associated with COC affected sediment.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** The No Action alternative does not reduce toxicity, mobility or volume of COCs.
7. **Short-Term Effectiveness:** The short-term effectiveness of this alternative is not applicable since no actions are taken.
8. **Implementability:** The No Action alternative does not require implementation or regulatory oversight.
9. **Cost:** $0

Molasses Bayou Waterway Alternative 2a

1. **Technology and Process Option:** Monitored Natural Recovery (MNR).
2. **Summary:** Technology reduces toxicity and bioavailability of COCs over time; multiple natural occurring processes are optimized to isolate, degrade, or remove COCs from the benthic environment.

The decrease in COC bioavailability is monitored, and adjustments made as necessary. For alternative 2a, MNR includes Molasses Bayou Waterway sub-areas that correspond to sample numbers: MB-10, MB-14, MB-18/MB-18R, MB-21, MB-24, MB-49, MB-52, MB-54, MB-60, and MB-61.

3. **Overall Protection of Human Health and the Environment:** Protection of the environment depends upon the rate of naturally driven degradation and dispersion processes. Alternative may provide protection of benthic invertebrates and the environment through (1) reduction of the bioavailability of COCs, (2) naturally occurring isolation, dispersion, or degradation of the COCs, and (3) non-invasive treatment of the current benthic habitat. MNR is a gradual process, with a recovery time of years to decades to meet the RAOs.
4. **Compliance with ARARs:** This alternative will comply with the chemical, action, and location ARARs listed in Tables 5, 6, and 7, including the Clean Water Act, Floodplain Management requirements, the Fish and Wildlife Coordination Act, and the National Historical Preservation Act.
5. **Long-Term Effectiveness and Permanence:** Moderate effectiveness and permanence. Effectiveness is dependent on physical, chemical, and biological recovery processes. MNR provides a greater degree of effectiveness over time by slowly reducing the pathway between COCs and the environment.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Reduces the toxicity of COC affected sediments by optimizing the natural biological processes in Molasses Bayou to break down PAHs and PCBs. Mobility of heavy metals may be reduced over time as the metals sorb to clays present in the existing sediment.
7. **Short-Term Effectiveness:** Low short-term effectiveness, due to the time necessary for natural processes to reduce the volume and toxicity of COCs.
8. **Implementability:** High level of implementability within the Molasses Bayou Waterway because little action is taken to optimize the naturally occurring processes. Heavy equipment, difficult to maneuver in areas surrounding the bayou, is not necessary. Administrative responsibilities are minimal, consisting of those associated with a sampling program for long term monitoring.
9. **Cost:**

Base Implementation Cost	$360,000
Remediation and Disposal Cost	$660,000
Present Worth Operation & Maintenance Cost	$434,000
Estimated Total Cost	$1,454,000

<u>Molasses Bayou Waterway Alternative 2b</u> [Selected Alternative]

1. **Technology and Process Option:** MNR, 12-inch removal/disposal, and containment with a 12-inch armored cap.
2. **Summary:** Alternative 2b includes MNR for the Molasses Bayou Waterway sub-areas that correspond to sample numbers MB-10, MB-14, MB-18/MB-18R, MB-49, MB-52, MB-54, and MB-60; and 12-inch removal/disposal and containment with a 12-inch armored cap for the sub-areas that correspond to sample numbers MB-24, MB-61, and MB-21. Best management practices will be used such as curtains to trap sediment that may become suspended during excavation and placement of the armored cap. The hydraulic capacity of the waterway will not be modified.
3. **Overall Protection of Human Health and the Environment:** The MNR portion of the alternative lowers the risk of interaction between benthic invertebrates and the sediment very gradually. Overall protection of the environment depends upon the rate of naturally driven degradation and dispersion processes. The removal/disposal and containment portion of the alternative, using armored cap, provides overall protection by isolation of COC-affected sediments from benthic invertebrates and the environment. This alternative will reduce erosion of the soft bayou sediments in the sub-areas where it

is implemented, and provide a new benthic habitat. The RAOs will be achieved at the completion of the remedy construction in the areas with removal/disposal and containment. MNR is a gradual process, with a recovery time of years to decades to meet the RAOs in the areas where MNR is applied. The Molasses Bayou Waterway is a lower energy environment that the Star Lake and Jefferson Canals located upstream, so some amount of the sediment carried by the flow from those canals will be deposited in the Molasses Bayou as the flow slows down. This additional sedimentation will aid in isolating the areas of contamination. Anecdotal statements from local community members indicate that the Molasses Bayou was formerly an open waterway that boats could easily pass through, but sections of the Bayou today are silted in and normal boat travel the full length is no longer possible. It is expected that this sediment transport and deposition in the Bayou will continue. However, it is difficult to estimate how quickly this may occur because it is dependent on the frequency and magnitude of future rain and storm events.

4. **Compliance with ARARs:** This alternative will comply with the chemical, action, and location ARARs listed in Tables 5, 6, and 7, including the Clean Water Act, Floodplain Management requirements, the Fish and Wildlife Coordination Act, and the National Historical Preservation Act.
5. **Long-Term Effectiveness and Permanence:** The MNR portion of the alternative provides a moderate level of long term effectiveness for the protection of ecological receptors and the reduction of risks associated with exposure to COCs. As natural processes occur over time, MNR provides a greater degree of effectiveness by slowly reducing the pathway between the COCs and the environment. The long-term effectiveness and permanence of removal, disposal, and an armor cap is high in the sub-areas where those actions are implemented. Excavation will interrupt the pathway between COC-affected sediments and receptors, and the migration of any remaining COCs would be continually inhibited by the placement of an armored cap.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** The MNR alternative reduces the toxicity of COC-affected sediments through the natural biological processes in Molasses Bayou. The mobility of metals may be reduced over time as the metals sorb to clays present in the existing sediment. The current within Molasses Bayou Waterway is weak, thus reduction of sediment volume by dispersion or reduction of mobility by placement of new sediment would occur slowly. In the sub-areas where removal/disposal and containment is implemented toxicity may be reduced depending on the concentration per unit volume remaining in place; however, volume is reduced by the amount of sediment excavated from the Site. Mobility is also reduced by the use of an armored cap. An armored cap will be used instead of a clay or composite cap because the area to be capped is adjacent to the Star Lake Canal which has boat traffic that generate wakes. The waves would likely result in excessive erosion of a clay or composite cap because the Bayou is very shallow and the bottom would be heavily impacted.
7. **Short-Term Effectiveness:** The MNR alternative provides a low level of short-term effectiveness since it depends upon the occurrence of natural processes over time. Short-term effectiveness of the removal and containment actions depends upon construction duration associated with sediment removal. Removal of COCs is effective immediately, though the water column may carry COC-affected sediments.
8. **Implementability:** High level of implementability for MNR within the Molasses Bayou Waterway because little action is taken to optimize the naturally occurring processes. Material will be excavated with hydraulic dredge equipment, staged in an area to be de-watered (by filter press or Geo-Tubes) and transported to a licensed off-Site disposal facility. The removal/disposal and containment portion of the alternative will have a lower level of implementability within the Molasses Bayou Waterway. Removal requires a high degree of accessibility and generates a large volume of sediment for disposal. Transportation of cap materials also requires a high degree of accessibility and there is no convenient location for staging of cap materials. However, the construction can be performed using barges and

pumping of materials, among other techniques, to complete. The ecological risk level in the area to be capped is generally higher than in other areas of the Bayou, and the area is generally accessible from the Star Lake Canal. The areas to be remediated by MNR have either lower levels of risk (less than a high priority (Level 4) ecological toxicity), or are not accessible for construction purposes. Finally, heavy equipment access and the preparation of staging and dewatering areas will cause damage to portions of the shallow and narrow bayou as well as the adjacent wetlands.

9. **Cost:**

Base Implementation Cost	$429,000
Remediation and Disposal Cost	$2,183,000
Present Worth Operation & Maintenance Cost	$657,000
Estimated Total Cost	$3,269,000

Molasses Bayou Waterway Alternative 3

1. **Technology and Process Option:** 12-inch removal/disposal; and containment with a 12-inch armored cap.
2. **Summary:** Alternative includes 12-inch removal/disposal and containment with a 12-inch armored cap for the Molasses Bayou Waterway AOI for sub-areas that correspond to sample numbers MB-10, MB-14, MB-18/MB-18R, MB-21, MB-24, MB-49, MB-52, MB-54, MB-60, and MB-61.
3. **Overall Protection of Human Health and the Environment:** Provides protection of benthic invertebrates and the environment through permanent removal of COC affected sediment. The RAOs will be achieved at the completion of the remedy construction.
4. **Compliance with ARARs**: This alternative will comply with the chemical, action, and location ARARs listed in Tables 5, 6, and 7, including the Clean Water Act, Floodplain Management requirements, the Fish and Wildlife Coordination Act, and the National Historical Preservation Act.
5. **Long-Term Effectiveness and Permanence:** High level of long-term effectiveness and permanence through removal of COC affected sediment.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Reduces volume of COC affected sediment, and reduction of mobility because affected sediment is removed from the site, and no longer has the ability to migrate to water or other sediment. In the polygons where removal/disposal and containment is implemented toxicity may be reduced depending on the concentration per unit volume remaining in place; however, volume is reduced by the amount of sediment excavated from the Site. Mobility is also reduced by the use of an armor cap.
7. **Short-Term Effectiveness:** Short-term effectiveness depends upon construction duration associated with sediment removal. Removal of COCs is effective immediately, though the water column may carry COC affected sediments.
8. **Implementability:** Low level of implementability within the Molasses Bayou Waterway. Dredging and excavation both require a high degree of accessibility and generate a large volume of sediment for disposal. Heavy equipment access and the preparation of staging and dewatering areas may cause damage to portions of this shallow wetland. Administrative responsibilities would include permitting and coordination of off-site transportation for removed sediment and for the disturbance of wetlands.
9. **Cost:**

Base Implementation Cost	$570,000
Remediation and Disposal Cost	$4,015,000
Present Worth Operation & Maintenance Cost	$1,076,000
Estimated Total Cost	$5,661,000

Molasses Bayou Waterway Preferred Alternative and Rational for Alternative Selection: Alternative 2b is selected over the other alternatives because this alternative provides greater reduction of toxicity, mobility and volume and provides greater short-term effectiveness than MNR alone. The ecological risk level in the area to be capped is generally higher than in other areas of the Molasses Bayou Waterway, and the area is generally accessible from the Star Lake Canal. The areas to be remediated by MNR have either lower levels of risk (less than a high priority (Level 4) ecological toxicity), or are not accessible for construction purposes.

There are three areas planned for removal and capping (MB-21, MB-24, and MB-61). Two of these areas (MB-21 and MB-24) have high priority (Level 4) ecological toxicity and are near Star Lake Canal. The third one, MB-61, has medium-high (Level 3) toxicity, but has Level 4 areas on both ends, and is subject to boat wakes from the Star Lake Canal. Because of the proximity to Level 4 areas and being located in a higher energy environment, removal and capping was selected for MB-61. There are seven polygons selected for the MNR remedy (MB-10, MB-14, MB-18, MB-49, MB-52, MB-54, and MB-60). Only two of these polygon areas (MB-10 and MB-14) have high priority (Level 4) ecological toxicity. All of the other five areas have medium-high (Level 3) ecological toxicity. Access to the seven MNR areas by construction equipment is not practical because the area is a heavily vegetated marsh and Molasses Bayou is not deep enough or wide enough to permit construction access by boat.

The MNR portion of the alternative lowers the risk of interaction between benthic invertebrates and the sediment very gradually. As natural processes occur over time, MNR provides a greater degree of effectiveness by slowly reducing the pathway between the COCs and the environment. The removal/disposal and containment portion of the alternative, using armored cap, provides overall protection by isolation of COC-affected sediments from benthic invertebrates and the environment. The portion of the Molasses Bayou Waterway to be capped is adjacent to the Star Lake Canal, and boat wakes from the canal may wash into the shallow Molasses Bayou and erode any clay or soil cap. Therefore an armor cap will be used; it will reduce erosion of the soft bayou sediments in the polygons where it is implemented. Alternative number 1 does not meet either of the threshold criteria. Of the remaining alternatives 2a, 2b, and 3 that achieve the threshold criteria, Alternative 2b has the best combination of reduction of toxicity, mobility, and volume, and long term effectiveness. Alternative 3 did rate slightly higher on long term effectiveness and reduction of toxicity, mobility, and volume, but it was also significantly lower in terms of implementability.

17.2.7 Molasses Bayou Wetland Comparative Analysis

Molasses Bayou Wetland Alternative 1

1. **Technology and Process Option:** Not applicable.
2. **Summary:** Not feasible because sediments pose an unacceptable risk to the benthic community.
3. **Overall Protection of Human Health and the Environment:** Would not provide protection of benthic invertebrates and the environment.
4. **Compliance with ARARs:** Not compliant because no remedial action has been taken.
5. **Long-Term Effectiveness and Permanence:** Alternative would provide a low level of long-term effectiveness and permanence because it would not result in any significant change in the risks associated with COC affected sediment.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Reduction of toxicity is low because this alternative does not involve a treatment technology that reduces the presence of COCs.
7. **Short-Term Effectiveness:** The short-term effectiveness of this alternative is not applicable since no actions are taken.
8. **Implementability:** Not applicable since no actions are taken.

9. **Cost:** $0

Molasses Bayou Wetland Alternatives 2a

1. **Technology and Process Option:** MNR.
2. **Summary:** Technology reduces toxicity and bioavailability of COCs over time; multiple natural occurring processes are optimized to isolate, degrade, or remove COCs from the benthic environment. The decrease in COC bioavailability is monitored. MNR would apply to sub-areas associated with the Molasses Bayou Wetland that correspond to sample numbers MB-26, MB-51, MB-56, MB-58, MB-59, MB-62, and MB-63.
3. **Overall Protection of Human Health and the Environment:** Overall protection of the environment depends upon the rate of naturally driven degradation and dispersion processes. Alternative may provide protection of benthic invertebrates and the environment through (1) reduction of the bioavailability of COCs, (2) naturally occurring isolation, dispersion, or degradation of the COCs, and (3) non-invasive treatment of the current benthic habitat. MNR is a gradual process, with a recovery time of years to decades to meet the RAOs.
4. **Compliance with ARARs:** This alternative will comply with the chemical, action, and location ARARs listed in Tables 5, 6, and 7, including the Clean Water Act, Floodplain Management requirements, the Fish and Wildlife Coordination Act, and the National Historical Preservation Act.
5. **Long-Term Effectiveness and Permanence:** Moderate long-term effectiveness and permanence. Effectiveness dependent on physical, chemical, and biological recovery methods optimized.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Reduces toxicity of COC affected sediments by the natural biological processes in Molasses Bayou to break down PAHs. The metals and PCBs will be covered by sedimentation processes over time and isolated from the environment. Mobility of heavy metals may be reduced over time as the metals sorb to clays present in the existing sediment.
7. **Short-Term Effectiveness:** Low level of short-term effectiveness, due to the time necessary for natural processes to reduce the volume and toxicity of COCs.
8. **Implementability:** High level of implementability within the Molasses Bayou Wetland because little action is taken to optimize the naturally occurring processes. Heavy equipment, difficult to maneuver in areas surrounding the bayou, is not necessary. Administrative responsibilities are minimal, consisting of those associated with a 10 year sampling program for long term monitoring.
9. **Cost:**

Base Implementation Cost	$360,000
Remediation and Disposal Cost	$954,000
Present Worth Operation & Maintenance Cost	$853,000
Estimated Total Cost	$2,167,000

Molasses Bayou Wetland Alternative 2b [Selected Alternative]

1. **Technology and Process Option:** MNR and containment with a 12-inch composite cap.
2. **Summary:** Alternative 2b includes MNR for the Molasses Bayou Wetland sub-areas that correspond to sample numbers MB-51, MB-56, MB-58, and MB-59; and containment with a 12-inch composite cap for the sub-areas that correspond to sample numbers MB-26, MB-62, and MB-63. The composite cap will consist of a 6-inch clay portion and a 6-inch soil portion.
3. **Overall Protection of Human Health and the Environment:** The MNR portion of the alternative lowers the risk of interaction between benthic invertebrates and the sediment very gradually. The composite cap portion of the alternative serves to protect the environment by isolation of COC

affected sediments from benthic invertebrates and the environment within the sub-areas where it is implemented. The composite cap will reduce erosion of the soft bottom, and provide a new benthic habitat. The RAOs will be achieved at the completion of the remedy construction in the areas with the composite cap. MNR is a gradual process, with a recovery time of years to decades to meet the RAOs in the areas where MNR is applied.

4. **Compliance with ARARs:** This alternative will comply with the chemical, action, and location ARARs listed in Tables 5, 6, and 7, including the Clean Water Act, Floodplain Management requirements, the Fish and Wildlife Coordination Act, and the National Historical Preservation Act.
5. **Long-Term Effectiveness and Permanence:** The MNR portion of the alternative provides a low level of initial effectiveness for reduction of risks. As natural processes occur over time, MNR provides a greater degree of effectiveness by slowly reducing the pathway between the COCs and the environment. The long-term effectiveness and permanence of a composite cap is high. The migration of COCs from erosion and bioturbation from the burrowing of benthic invertebrates will be continually inhibited in the sub-areas where a composite cap is implemented.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** The MNR portion of the alternative slowly reduces the toxicity of COC affected sediments by the natural biological processes. The mobility of heavy metals may be reduced over time as the metals sorb to clays present in the existing sediment. A composite cap will reduce the mobility of the constituents by providing a barrier between the affected sediment and the ecological system in the sub-areas where it is implemented.
7. **Short-Term Effectiveness:** The MNR portion has a low level of short-term effectiveness due to the time necessary for natural processes to reduce the volume and toxicity of COCs. MNR implementation provides no immediate protection of ecological receptors or reduction of risks; however, implementation does not cause any disturbance of the marsh or redistribution of COC-affected sediments as may occur with alternatives that are more active. Short-term effectiveness of the composite cap depends upon duration of implementation, including time for mobilization, staging of equipment and materials, and stabilization of the area following cap installation.
8. **Implementability:** The MNR portion has a high level of implementability within the Molasses Bayou Wetland because little action is required to optimize the naturally occurring processes, and heavy equipment, which is difficult to maneuver in the wetland, is not required. The containment portion has a lower level of implementability that is related to wetland accessibility, which impedes delivery of cap materials and equipment. Also, there is no convenient location for staging of cap materials. However, the construction can be performed using barges and pumping of materials to complete. The ecological risk level in the area to be capped is generally higher than in other areas of the Wetland, and the area is generally accessible from the Star Lake Canal and Molasses Bayou. The areas to be remediated by MNR have either lower levels of risk (less than a high priority (Level 4) ecological toxicity), or are not accessible for construction purposes. Heavy equipment access and the preparation of staging and dewatering areas will cause damage to portions of the wetlands. Finally, the cap must be anchored, but the loose sediment within the wetland is not conducive to anchoring methods, and the use of erosion control mats may be required.
9. **Cost:**

Base Implementation Cost	$540,000
Remediation and Disposal Cost	$3,213,000
Present Worth Operation & Maintenance Cost	$1,076,000
Estimated Total Cost	$4,829,000

Molasses Bayou Wetland Alternatives 2c and 2d

1. **Technology and Process Option:** Both Alternative 2c and 2d include MNR and 12-inch

removal/disposal; Alternative 2c adds a containment component with a 12-inch Armored Cap.

2. **Summary:** Technology reduces toxicity and bioavailability of COCs over time; multiple naturally occurring processes are optimized to isolate, degrade, or remove COCs from the benthic environment. The decrease in COC bioavailability is monitored, and adjustments made as necessary. The MNR portion will apply to sub-areas that correspond to sample numbers: MB-51, MB-56, MB-58, and MB-59; and the 12-inch removal/disposal and containment portion with a 12-inch armored cap (for Alternative 2c only) for the sub-areas that correspond to sample numbers MB-26, MB-62, and MB-63.
3. **Overall Protection of Human Health and the Environment:** Overall protection of the environment depends upon the rate of naturally driven degradation and dispersion processes. Alternatives may provide protection of benthic invertebrates and the environment through (1) reduction of the bioavailability of COCs, (2) naturally occurring isolation, dispersion, or degradation of the COCs, and (3) additional isolation of the contamination provided by the armor cap with Alternative 2d. The RAOs will be achieved at the completion of the remedy construction in the areas with removal/disposal and containment. MNR is a gradual process, with a recovery time of years to decades to meet the RAOs in the areas where MNR is applied.
4. **Compliance with ARARs:** This alternative will comply with the chemical, action, and location ARARs listed in Tables 5, 6, and 7, including the Clean Water Act, Floodplain Management requirements, the Fish and Wildlife Coordination Act, and the National Historical Preservation Act.
5. **Long-Term Effectiveness and Permanence:** Moderate long-term effectiveness and permanence. Effectiveness dependent on physical, chemical, and biological recovery methods optimized.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** The volume will be reduced in the areas where excavation and disposal are used. Natural biological processes in Molasses Bayou will break down PAHs. The PCBs and metals will be isolated over time by naturally occurring sedimentation, although no significant treatment will occur. The mobility of heavy metals may be reduced over time as the metals sorb to clays present in the existing sediment.
7. **Short-Term Effectiveness:** Low level of short-term effectiveness, due to the time necessary for natural processes to reduce the volume and toxicity of COCs.
8. **Implementability:** High level of implementability within the Molasses Bayou Wetland because little action is taken to optimize the naturally occurring processes. Heavy equipment, difficult to maneuver in areas surrounding the bayou, is not necessary except of the removal and containment portions.
9. **Cost – Alternative 2c**

Base Implementation Cost	$2,040,000
Remediation and Disposal Cost	$12,764,000
Present worth Operation & Maintenance Cost	$1,076,000
Estimated Total Cost	$15,880,000

12. **Cost – Alternative 2d**

Base Implementation Cost	$2,040,000
Remediation and Disposal Cost	$10,917,000
Present Worth Operation & Maintenance Cost	$1,076,000
Estimated Total Cost	$14,033,000

Molasses Bayou Wetland Alternative 3

1. **Technology and Process Option:** Containment with a 12-inch composite cap (no excavation).
2. **Summary:** Technology isolates COCs from the benthic environment. This alternative will be implemented within Molasses Bayou Wetland sub-areas that correspond to sample numbers MB-26, MB-51, MB-56, MB-58, MB-59, MB-62, and MB-63.

3. **Overall Protection of Human Health and the Environment:** Alternative provides protection of benthic invertebrates and the environment through (1) isolation of COCs, (2) control of risk to benthic health by eliminating contact with COCs, and (3) provision of an unaffected benthic habitat. The RAOs will be achieved at the completion of the remedy construction.
4. **Compliance with ARARs:** This alternative will comply with the chemical, action, and location ARARs listed in Tables 5, 6, and 7, including the Clean Water Act, Floodplain Management requirements, the Fish and Wildlife Coordination Act, and the National Historical Preservation Act.
5. **Long-Term Effectiveness and Permanence:** High level of long-term effectiveness and permanence because the estimated breakthrough of organic COCs is on the order of hundreds of years. Composite cap will be designed to have high resistance to erosion.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Reduces mobility by providing a barrier between the constituent affected sediment and the environment. Toxicity and volume are not reduced with this alternative.
7. **Short-Term Effectiveness:** Short term effectiveness of the composite cap depends upon duration of implementation. This includes time for standard construction mobilization and staging of equipment, cap material placement, and stabilization of the area following cap installation.
8. **Implementability:** Low level of implementability within the Molasses Bayou Wetland. The wetland has a low degree of accessibility, which impedes delivery of cap materials and equipment. The cap must be anchored, but the loose sediment within the wetland is not conducive to accepted anchoring methods. No convenient location exists for staging of cap materials.
9. **Cost:**

Base Implementation Cost	$540,000
Remediation and Disposal Cost	$2,839,000
Present Worth Operation & Maintenance Cost	$223,000
Estimated Total Cost	$3,602,000

Molasses Bayou Wetland Alternative 4

1. **Technology and Process Option:** 12-inch removal/disposal outside of the pipeline servitudes, and containment with a 12-inch Armored Cap.
2. **Summary:** This alternative will be implemented outside of the pipeline servitude within Molasses Bayou Wetland sub-areas that correspond to sample numbers MB-26, MB-51, MB-56, MB-58, MB-59, MB-62, and MB-63.
3. **Overall Protection of Human Health and the Environment:** Provides protection of benthic invertebrates and the environment through permanent removal of COC affected sediment except in the pipeline servitude area. The RAOs will not be achieved in the pipeline servitude areas.
4. **Compliance with ARARs:** This alternative will be designed to comply with chemical, location, and action specific ARARs for the Site for areas outside the pipeline servitude. The COC affected material remaining in the pipeline servitude area may not comply with ARARs for the Site.
5. **Long-Term Effectiveness and Permanence:** High level of long-term effectiveness and permanence through removal of COC affected sediment.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Reduces volume of COC affected sediment, and reduction of mobility because affected sediment is removed from the site, and no longer has the ability to migrate to water or other sediment.
7. **Short-Term Effectiveness:** Short-term effectiveness of this alternative depends upon construction duration associated with sediment removal. Removal of COCs is effective immediately, though the water column may carry COC affected sediments.

8. **Implementability:** Low level of implementability within the Molasses Bayou Wetland. Dredging and excavation both require a high degree of accessibility and generate a large volume of sediment for disposal. Heavy equipment access and the preparation of staging and dewatering areas may cause damage to portions of this shallow wetland. Administrative responsibilities would include permitting and coordination of offsite transportation for removed sediment and for the disturbance of wetlands.
9. **Cost:**

Base Implementation Cost	$2,040,000
Remediation and Disposal Cost	$29,680,000
Present Worth Operation & Maintenance Cost	$223,000
Estimated Total Cost	$31,943,000

Molasses Bayou Wetland Alternative 5

1. **Technology and Process Option:** 12- inch removal/disposal outside of the pipeline servitude area.
2. **Summary:** This alternative will be implemented outside of the pipeline servitude within Molasses Bayou Wetland sub-areas that correspond to sample numbers MB-26, MB-51, MB-56, MB-58, MB-59, MB-62, and MB-63.
3. **Overall Protection of Human Health and the Environment:** Provides protection of benthic invertebrates and the environment through permanent removal of COC affected sediment, except in the pipeline servitude area. The RAOs will not be achieved in the pipeline servitude areas.
4. **Compliance with ARARs:** This alternative will be designed to comply with chemical, location, and action specific ARARs for the Site for areas outside the pipeline servitude. The COC affected material remaining in the pipeline servitude area may not comply with ARARs for the Site.
5. **Long-Term Effectiveness and Permanence:** High level of long-term effectiveness and permanence through removal of COC affected sediment outside of the pipeline servitude area.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Reduces volume of COC affected sediment, and reduction of mobility because affected sediment is removed from the site, and no longer has the ability to migrate to water or other sediment.
7. **Short-Term Effectiveness:** Short-term effectiveness of this alternative depends upon construction duration associated with sediment removal. Removal of COCs is effective immediately, though the water column may carry COC affected sediments.
8. **Implementability:** Low level of implementability within the Molasses Bayou Wetland. Dredging and excavation both require a high degree of accessibility and generate a large volume of sediment for disposal. Heavy equipment access and the preparation of staging and dewatering areas may cause damage to portions of this shallow wetland.
9. **Cost:**

Base Implementation Cost	$2,040,000
Remediation and Disposal Cost	$24,893,000
Present Worth Operation & Maintenance Cost	$223,000
Estimated Total Cost	$27,156,000

Molasses Bayou Wetland Preferred Alternative and Rational for Alternative Selection:
Alternative 2b is selected over the other alternatives because this alternative provides protection of benthic invertebrates and upper trophic level receptors. The ecological risk level in the area to be capped is generally higher than in other areas of the Wetland, and the area is generally accessible from the Star Lake Canal and Molasses Bayou. The areas to be remediated by MNR have either lower levels of risk (less than a high priority (Level 4) ecological toxicity), or are not accessible for construction purposes. Figure 4 shows the Thiessen polygons that are to be remediated. The yellow

colored polygons have a medium-high (Level 3) ecological toxicity, and the red polygons have a high priority (Level 4) ecological toxicity. The polygons to be treated by MNR in the Molasses Bayou Wetland (MB-51, MB-56, MB-58, and MB-59) are Level 3 except for MB-56, which is Level 4. Access to MB-56 by construction equipment is not practical because the area is a heavily vegetated marsh and Molasses Bayou there is not deep enough or wide enough to permit construction access by boat.

The soil portion of the composite cap will provide better habitat than other cap materials while the clay portion will provide erosion protection. This alternative will achieve risk reduction by combining MNR with capping of the wetland areas that are accessible from Molasses Bayou. Alternative numbers 1, 4, and 5 do not meet either one or both of the threshold criteria. Of the remaining alternatives 2a, 2b, 2c, 2d, and 3 that achieve the threshold criteria, Alternative 2b has the best combination of reduction of toxicity, mobility, and volume, implementability, and long term effectiveness. Alternatives 4 and 5 did rate slightly higher on reduction of toxicity, mobility, and volume, and long term effectiveness, but they were both significantly lower in terms of implementability.

17.2.8 Summary of Selected Remedy Costs

Jefferson Canal - Alternative 3b:	**$ 1,246,000**
Jefferson Canal Spoil Pile - Alternative 2b:	**$ 2,378,000**
Former Star Lake – Alternative 2b:	**$ 5,202,000**
Star Lake Canal – Alternative 2:	**$ 4,302,000**
Gulf States Utility Canal – Alternative 2:	**$ 659,000**
Molasses Bayou Waterway – Alternative 2b:	**$ 3,269,000**
Molasses Bayou Wetlands – Alternative 2b:	**$ 4,829,000**
TOTAL COST OF ALTERNATIVES:	**$21,885,000**

17.2.9 Cost Estimate Discussion

The "Base Implementation Cost" listed for each alternative includes mobilization and demobilization costs, site preparation, and site characterization analysis costs. The "Remediation and Disposal Costs" include excavation, dredging, capping, backfill, other materials, and disposal costs at an offsite disposal facility. The "Operation and Maintenance Costs" include engineered monitoring equipment including installation, and annual maintenance and monitoring costs.

This cost estimate uses the unit cost method where work is divided into as many operations or items as are required. A unit of measurement is determined. The total quantity of work under each item is apportioned into a proper unit of measurement. The total cost per unit quantity of each item is determined by estimation, by collection of vendor price quotations, or use of citation of publisher unit costs. The total cost for the item is found by multiplying the cost per unit quantity by the number of units. For example, while estimating the cost of a building, the quantity of brickwork in the building would be measured in cubic meters. The total cost (which includes cost of materials, labor, plant, overheads and profit) per cubic meter of brickwork would

be found; this unit cost, multiplied by the number of cubic meters of brickwork in the building, would give the estimated cost of brickwork. This method has the advantage that the unit costs on various jobs can be readily compared and that the total estimate can easily be corrected for variations in quantities.

The project cost information is evaluated to compare remedial alternatives and to evaluate the comparison among alternatives. Estimated costs for each alternative were prepared on a unit-cost basis. Material, equipment, and labor quantities specific to each alternative were each assigned a unit cost. For each alternative, the extended cost of each quantity listed in the alternative was determined by multiplication of that quantity by the corresponding unit cost, and extended cost values were then summed to develop the total estimated cost of each alternative. Costs associated with each alternative were estimated for initial capital expenditures at project commencement and for annual operation and maintenance (O&M) expenditures, as appropriate for each alternative. Annual O&M costs also include monitoring costs, as applicable.

For each alternative, an equivalent net present value (NPV) of estimated annual O&M costs was developed. The estimated NPV of annual O&M costs for each alternative was determined on the basis of an average annual discount rate of 7.0 percent and an estimated project life of 10 years. The 7.0 percent discount rate is based on EPA guidance for remedial actions at sites other than Federal Facilities, which rely on different criteria. The 10 year period for cost estimating purposes is based on an estimate of how long it will take the MNR areas to reach the RGs. This may occur earlier than 10 years if a large storm event(s) results in the deposition of a large amount of new sediment in the MNR areas; or it may take many decades to reach the RAOs as noted above. While the actual time to reach the RAOs for the Site is subject to a high level of uncertainty, operation and maintenance, including MNR sampling, will continue as long as required to ensure protectiveness at the Site.

Total estimated costs of each alternative evaluated were determined through addition of total initial capital expenditures and total estimated NPV of annual O&M costs. The total estimated cost of each alternative was used for the basis of cost comparison between alternatives within each AOI.

Estimated unit costs presented for each alternative are based on typical values from environmental remediation and engineering projects of similar size and scope, price quotations requested from equipment and service vendors, and other published cost values for CERCLA sites from public-sector and other sources. Where practical, the same unit cost values were used for comparable unit quantities in all alternatives that were compared, so that cost differences between alternatives reflected differences in alternative scope not biased by differences in unit cost for comparable cost items.

Expenditures that occur over different periods were analyzed using the present-worth analysis, which discounts all future costs to a base year. Present-worth analysis allows the cost of remedial action alternatives to be compared on the basis of a single figure which represents the amount of money that, if invested in the base year and disbursed as needed, would be sufficient to cover all costs associated with the life of the remedial project. Assumptions associated with the present-worth calculations include a discount rate of 7.0 percent before taxes and after inflation, cost estimates in the planning years in constant dollars, a 10-year period for O&M, and one year of construction to implement the remedy.

The order-of-magnitude cost estimates were prepared using USEPA's *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (USEPA, 2000) in conjunction with a standard "unit cost" approach for each alternative. In this approach all alternatives are divided into as many operations or items as are required and a unit of measurement is assigned to each (ton, days, cubic yard, etc.). Total operation cost is then calculated by multiplying the cost per unit quantity by the number of units needed

for that defined operation. The summation of all total unit costs is then the total cost for that particular alternative.

The cost summary tables include capital costs and O&M costs. Capital costs consist of direct and indirect costs. Direct costs include the cost of construction, equipment, land and Site development, labor, transportation, and disposal. Indirect costs include engineering expenses, license or permit costs, and contingency allowances (20 percent). Annual O&M costs are the post-construction costs required for the continued effectiveness of the remedy. Components of annual O&M costs include the cost of maintenance materials and labor, monitoring, and periodic Site reviews.

Additional investigation activities and evaluations will be performed during the remedial design phase. The volume of sediment which requires removal and dewatering or disposal may be refined and cap designs will be finalized based on information collected during the remedial design phase. The cost estimates were prepared using quotes provided by reliable suppliers, technology reference documents, and actual costs from other sediment remediation projects available at the time of preparation of this submittal.

In summary, the cost estimates were prepared in order to compare the different remedial alternatives and disposal options by AOI. The actual cost of the selected remedial alternative will depend on a number of factors which include:

- Final sediment/soil volumes removed;
- Final cap design and associated material volumes;
- Inclusion of additional emerging technologies that are not currently proposed within the alternatives presented in the Feasibility Study;
- Competitive market conditions; and
- Actual labor and material costs

The information on costs is based on the best available information regarding the anticipated scope of the remedial alternatives. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. Major changes may be documented in the form of a memorandum in the Administrative Record file, an ESD, or a ROD amendment. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.

17.3 State Agency Acceptance

State Agency Acceptance considers whether the State agrees with U.S. EPA's analyses of the FS Report and Preferred Remedy in the Proposed Plan. The State of Texas has been an active participant in preparation of the Proposed Plan as well as this ROD. The State of Texas supports the Selected Remedy.

17.4 Community Acceptance

Community Acceptance considers whether the local community agrees with U.S. EPA's analyses and preferred alternative described in the Proposed Plan. During the public comment period for the Proposed Plan, both oral and written comments were received. The comments and the responses are included in the Responsiveness Summary, Part 3 of this ROD. Based on EPA's interpretation of comments received during the public comment period and the questions received at the public meeting, the community concurs with the Selected Remedy identified in this ROD.

18.0 PRINCIPAL THREAT WASTE

The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by a site wherever practicable. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained, or would present a significant risk to human health or the environment should exposure occur. The principal threat concept is applied to the characterization of source materials at a Superfund site. A source material is material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration of contamination to groundwater, surface water or air, or acts as a source for direct exposure. Contaminated groundwater generally is not considered to be a source material; however, non-aqueous phase liquids (NAPL) in groundwater may be viewed as source material. Non-principal threat wastes are those source materials that generally can be reliably contained and that would present only a low risk in the event of exposure.

The Star Lake Canal Site contains relatively low levels of COCs that do not result in an unacceptable risk to human health, although they do represent an ecological risk. The Site does not contain highly toxic materials and does not contain any principle threat waste.

19.0 SELECTED REMEDY

The selected remedy for the Site includes removal/disposal of contaminated materials followed by the use of containment to provide a barrier between contaminated material remaining and biological receptors (i.e., benthic invertebrates and upper trophic receptors), and take into account the current and reasonably anticipated future land use. The selected remedy includes the application of ICs for areas where containment is used. The purpose of these ICs is to provide information that is associated with each tract regarding the location of the cap, and to protect the integrity of the cap by limiting any digging or dredging in the area that could interfere with the performance of the cap. The ICs consist of either a restrictive covenant or a deed notice. The criteria used to establish the use of ICs and the type(s) of ICs at a Texas site are specified in 30 TAC Chapter 350 Subchapter F (Institutional Controls). Monitored natural recovery is also a part of the selected remedy. The Selected Remedy for each of the seven areas of the Site is as follows:

- **Jefferson Canal**

  Alternative 3b - 12-inch Removal/Disposal in Certain Areas and Containment with a 12-inch Soil Cap or a 12-Inch Erosion Control Mat in Pipeline Servitude: All sub-areas of interest (JC-2, JC-7, JC-13, JC-18, and JC-19) with a medium high or high probability of ecological toxicity will be excavated to a depth of 12-inches except in the pipeline servitude areas. Excavation activities within sub-areas with pipeline servitudes will maintain a 25 foot boundary to ensure pipeline security. This alternative is selected because it will achieve the key RAOs of protecting benthic invertebrates and upper trophic receptors. This alternative will achieve risk reduction by excavating 12 inches of material from portions of Jefferson Canal. Following excavation, a 12-inch soil cap will be placed on areas outside of the pipeline servitude and a 12-inch erosion control mat will be placed on the pipeline servitude. All removed sediment would be dewatered, if needed, and properly disposed off-Site. These excavated areas shall be backfilled with clean fill and stabilized along the bottom and sides of the canal. Additionally, sediment and erosion control best management practices such as silt curtains will be installed in the canal to prevent the migration of COC-affected sediments resuspended during the excavation process. The remedy will maintain or improve the hydraulic/storage capacity of the Jefferson Canal area so that the drainage

performance will not be detrimentally impacted by the selected remedy. Further, the Remedial Design will include an assessment of options for improving the storage or fluid handling capacity of the areas following the remedial action. The Preferred Alternative meets the threshold criteria and provides the best balance of tradeoffs among the balancing criteria.

- **Jefferson Canal Spoil Pile**

Alternative 2b - Removal/Disposal of Mounds to Grade and Containment with two-foot Composite Cap: Cap composition will consist of a 12-inch layer of clay overlaid with a 12-inch layer of top soil to allow for vegetative stabilization. The composite cap will be placed over the entire AOI, including the pipeline servitude area. The composite cap composition and thickness will be designed to prevent infiltration of rainwater and erosion by surface runoff. In addition, potential ROCs that utilize the Site generally burrow less than two feet below the ground surface and the two-foot cap will minimize ROC access to the underlying material. A set-back or servitude will not be disturbed within 25 feet of the pipelines extending through the Jefferson Canal Spoil Pile AOI except as described below. The mounds will be removed to grade. The mounds within the pipeline servitude will be removed with light equipment if during the Remedial Design it is confirmed that this can be implemented without compromising the integrity of any pipelines. This alternative will achieve risk reduction by removal and disposal of soil pile mounds to grade and then containment with a composite cap to interrupt the exposure pathway between soil contaminants and upper trophic receptors. The remedy will maintain or improve the hydraulic/storage capacity of the Jefferson Canal Spoil Pile area so that the drainage performance of the areas will not be detrimentally impacted by the selected remedy. Further, the Remedial Design will include an assessment of options for improving the storage or fluid handling capacity of the area following the remedial action.

- **Former Star Lake**

Alternative 2b - 12-inch Removal/Disposal and Containment with a 12-Inch Clay Cap: The area outside the pipeline servitudes will be excavated to a depth of 12 inches and contained with a 12-inch clay cap. If it is determined in the Remedial Design that pipeline integrity will not be compromised, the pipeline servitudes will be contained with either a 12-inch erosion control mat or a composite cap depending on the location of the area along the bank of the Star Lake Canal. All removed sediment would be dewatered, if needed, and properly disposed off-Site. The hydraulic capacity of the area will not be modified. The partial 12-inch removal will provide protection of the environment through the elimination of the COC-affected sediment and a disruption of the pathway between the ROCs and the COCs in areas outside the pipeline servitude. An clay cap will provide a barrier between the benthic invertebrates and COC-affected sediment, and resist erosion from an inundated drainage canal.

- **Star Lake Canal**

Alternative 2 - Removal/Disposal and 12-inch Clay Cap: The canal sediment will be excavated to a depth of 12-inch for polygons that correspond to sample numbers SLC-6 and SLC-11. Hydraulic excavation is the preferred removal technology for the navigable portion of the Star Lake Canal (the polygon associated with sample number SLC-11). The excavated sediment will be dewatered and disposed in an authorized disposal facility. Sediment and erosion control will be in place to minimize any COC-affected sediments from becoming resuspended and entering the waterway during excavation and placement of the clay cap. All pipelines at or near the Star Lake Canal AOI will be taken into consideration for the design. It is assumed that the pipeline under the Star Lake Canal is deep enough to allow for sediment removal. Through evaluation of easements, coordination with pipeline owners and/or

completion of a geophysical survey, the pipeline's operational status and location will be determined during the Remedial Design phase. If sediment removal is not possible, the 12-inch clay cap will be installed on the pipeline servitude if it is determined in the Remedial Design that this can be done without compromising the integrity of the pipelines. The clay cap will be designed to provide isolation between the affected sediments and benthic invertebrates and to resist erosion. The hydraulic capacity of the canal will not be modified.

- **Gulf States Utility Canal**

Alternative 2 - Containment with a 12-inch Composite Cap: This alternative includes containment with a 12-inch composite cap for the polygon corresponding to sample GSUC-7. Erosion control matting will also be used to stabilize the canal embankment. All pipelines at or near the Gulf States Utility Canal AOI will be taken into consideration for this remedial alternative. Based on available information, it is assumed that there are no pipeline crossings in the polygons to be remediated in the Gulf States Utility Canal. Through evaluation of easements, coordination with pipeline owners and/or completion of a geophysical survey, the operational status and location of the pipelines will be determined during the Remedial Design phase. The containment alternative using a composite cap serves to protect the environment by isolation of COC-affected sediments from benthic invertebrates and the environment. This alternative will reduce erosion of the canal bottom and provide a new benthic habitat.

- **Molasses Bayou Waterway**

Alternative 2b - Monitored Natural Recovery (MNR); 12-inch Removal/Disposal; and 12-inch Armored Cap: Alternative includes MNR for the Molasses Bayou Waterway polygons that correspond to sample numbers MB-10, MB-14, MB-18/MB-18R, MB-49, MB-52, MB-54, and MB-60; and 12-inch removal/disposal and containment with a 12-inch armored cap for the polygons that correspond to sample numbers MB-24, MB-61, and MB-21. Best management practices will be implemented such as curtains to trap any affected sediment that may become resuspended in the water column by the excavation process, or placement of backfill and cap materials. The MNR portion of the alternative lowers the risk of interaction between benthic invertebrates and the sediment very gradually. The removal/disposal and containment portion of the alternative, using armored cap, provides overall protection by isolation of COC-affected sediments from benthic invertebrates and the environment.

This alternative will reduce erosion of the soft bayou sediments in the polygons where the armor cap is implemented. The long-term effectiveness will be monitored through a sampling program to be designed during the Remedial Design. The hydraulic capacity of the waterway or the soil/water topography will not be modified.

- **Molasses Bayou Wetland**

Alternative 2b - MNR and 12-inch Composite Cap: This selected remedy includes MNR for the Molasses Bayou Wetland polygons that correspond to sample numbers MB-51, MB-56, MB-58, and MB-59; and containment with a 12-inch composite cap for the polygons that correspond to sample numbers MB-26 MB-62, and MB-63. The composite cap portion of the selected remedy serves to protect the environment by isolation of COC-affected sediments from benthic invertebrates and the environment within the polygons where it is implemented. The composite cap will reduce erosion of the soft bottom, and provide a new benthic habitat. As natural processes occur over time, MNR slowly reduces the pathway between the COCs and the environment.

Long-term effectiveness will be monitored through a sampling program developed during the Remedial Design. This alternative will achieve risk reduction by combining MNR with capping of the wetland areas that are accessible by the Star Lake Canal.

20.0 STATUTORY DETERMINATIONS

Under CERCLA §121 and the NCP §300.430(f)(5)(ii), the EPA must select remedies that are protective of human health and the environment, comply with ARARs (unless a statutory waiver is justified), are cost-effective, and use permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable.

In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the toxicity, mobility, or volume (TMV) of hazardous substances, pollutants, and contaminants as a principal element, and it includes a bias against offsite disposal of untreated wastes. The following sections discuss how the selected remedy meets these statutory requirements.

20.1 Protection of Human Health and the Environment

The selected remedy for the sediment and soil at this Site will meet the RAOs and cleanup levels as well as provide adequate protection of human health and the environment. The selected remedy, which includes various combinations of removal/disposal, containment, and MNR as described above for the seven AOIs of the Site, is expected to control risks and potential migration.

These remedial actions will be effective and permanent in the long-term provided long-term monitoring, O&M, and five year reviews are performed. The Site will be available for residential and/or commercial or industrial use, which is compatible and consistent with the land use in the area.

20.2 Compliance with Applicable or Relevant and Appropriate Requirements

The selected remedy will comply with all Federal and any more stringent State and local ARARs that pertain to the Site. The remediation levels and RAOs used in the design of the selected remedy were developed based on the ARARs described in this ROD. Based on existing information, the proposed design of the selected remedy should ensure that the remedial action, once fully and successfully implemented, will comply with all ARARs identified in this ROD. The selected remedy is expected to comply with identified ARARs through the use of standard engineering and waste management techniques.

20.3 Cost Effectiveness

The selected remedy is cost-effective because the remedy costs are proportional to its overall effectiveness (see 40 CFR §300.430(f)(l)(ii)(D)). This determination was made by evaluating the overall effectiveness of those alternatives that satisfied the threshold criteria (i.e., that are protective of human health and the environment and comply with all Federal and any more stringent State/Local ARARs, or as appropriate, waive ARARs). Overall effectiveness was evaluated (in the FS Report) by assessing the balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment, short-term effectiveness, and implementability).

The overall effectiveness of each alternative was then compared to each alternative's cost to determine cost-effectiveness. The selected remedies are generally in the lower range of the costs for the alternatives considered, but are also the most effective because they achieve the best combination of the Balancing Criteria as discussed above.

20.4 Use of Permanent Solutions to the Maximum Extent Practicable

The EPA has determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner. Of those alternatives that are protective of human health and the environment and comply with ARARs, EPA has determined that the selected remedy provides the best balance of trade-offs in terms of the five balancing criteria, while also considering the statutory preference for treatment as a principal element, bias against off-site treatment and disposal, and considering State and community acceptance. The selected remedy is necessary to ensure the long-term effectiveness and permanence of this cleanup.

20.5 Preference for Treatment as a Principal Element

Reduction of TMV through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy. Treatment is not a primary component of the selected remedy. However, the Site does not contain principle threat wastes, and reduction of TMV to an extent will be achieved by the following:

- The Jefferson Canal selected remedy reduces mobility and volume of COC affected sediments with the removal/disposal component. The armor cap further reduces mobility through the prevention of erosion.
- The Jefferson Canal Spoil Pile selected remedy reduces the toxicity and volume within the excavated areas and the cap installation reduces the mobility.
- The Former Star Lake selected remedy reduces mobility and volume of COC affected sediments that are excavated. The clay cap will further isolate any remaining affected sediment, and reduce erosion.
- The Star Lake Canal selected remedy reduces the volume, and the mobility is eliminated as a result of the cap.
- The Gulf States Utility Canal selected remedy reduces mobility by providing a barrier between the constituent affected sediment and the environment.
- The Molasses Bayou Waterway selected remedy MNR component slowly reduces the toxicity of some COCs in sediments through the natural biological processes in Molasses Bayou. However, the toxicity of other COCs, such as metals, is not changed. The current within Molasses Bayou Waterway is weak, thus reduction of sediment volume by dispersion or reduction of mobility by placement of new sediment would occur slowly. Volume is reduced by the amount of sediment excavated from the Site, and mobility is also reduced by the use of an armored cap.
- Molasses Bayou Wetland selected remedy MNR component slowly reduces the toxicity of some COCs in sediments by the natural biological processes, but not other COCs, such as metals. A composite cap will reduce the mobility of the constituents by providing a barrier between the affected sediment and the ecological system in the sub-areas where it is implemented.

20.6 Five-Year Review Requirements

Because the selected remedy will result in contamination in sediment that is above the remediation goals for the MNR remedy, a review must be conducted within five years of the initiation of the remedial action to

ensure that the remedy is, or will be, protective of human health and the environment. Pursuant to CERCLA Section 121(c), 42 U.S.C. § 9621(c), and as provided in the current guidance on Five Year Reviews [OSWER Directive 9355.7-03B-P, *Comprehensive Five-Year Review Guidance* (June 2001)], EPA must conduct a review within five years from the initiation of construction at the Site. This five year review will be a statutory review due to the sediment caps included in the selected remedy.

21.0 DOCUMENTATION OF SIGNIFICANT CHANGES FROM PREFERRED ALTERNATIVE OF PROPOSED PLAN

The Proposed Plan for the Site was released for public comment in June 2013. The Proposed Plan for the Site recommended the following remedies for AOIs at the Site:

- **Jefferson Canal:** Alternative 3b - 12-inch Removal/Disposal and Containment in certain areas.
- **Jefferson Canal Spoil Pile:** Alternative 2b - Removal/Disposal of mounds to grade and Containment with a two-foot composite cap.
- **Former Star Lake:** Alternative 2b - 12-inch Removal/Disposal and Containment in certain areas.
- **Star Lake Canal:** Alternative 2 – 12-inch Removal/Disposal and a 12-inch Clay Cap.
- **Gulf States Utility Canal:** Alternative 2 – Containment with a 12-inch Composite Cap.
- **Molasses Bayou Waterway:** Alternative 2b - MNR in certain areas, and 12-inch Removal/Disposal with a 12-inch Armored Cap in other areas.
- **Molasses Bayou Wetland:** Alternative 2b - MNR in certain areas and a 12-inch Composite Cap in other areas.

The EPA reviewed all written and verbal comments submitted during the public comment period. As a result, there is an additional requirement for the selected remedy for the Jefferson Canal Spoil Pile area. The additional requirement consists of a provision to maintain the hydraulic/storage capacity of the Jefferson Canal Spoil Pile area consistent with the requirements and conditions of the U.S. Army Corps of Engineers so that the storage and drainage performance of the area will not be detrimentally impacted by the selected remedy. It was determined that no other significant changes to the remedy, as identified in the Proposed Plan for the Site, were necessary or appropriate.

22.0 REFERENCES

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PART 3: RESPONSIVENESS SUMMARY

23.0 STAKEHOLDER COMMENTS AND LEAD AGENCY RESPONSES

The Responsiveness Summary summarizes the comments received regarding both the remedial alternative and general concerns about the Site submitted during the public comment period and the EPA's responses to these comments. The Administrative Record file for the Site contains all of the information and documents supporting this ROD. This Administrative Record file includes a transcript of the public meeting held by the EPA on July 11, 2013, to describe the preferred alternative. The questions and answers discussed during this meeting can be found in the meeting transcript included as part of the Administrative Record.

This Responsiveness Summary summarizes comments submitted during the public comment period and presents the EPA's written response to each issue, in satisfaction of community relations requirements of the NCP. The EPA's responses to comments received during the public meeting are provided below and in some cases include subsequent expanded responses to those comments as appropriate.

Comment: How long is all of this supposed to take?

EPA Response: The schedule will be set during the Remedial Design, which will be completed before the construction starts. However, it is expected the design, which will include additional sampling and determination of the exact pipeline locations and depths, will take approximately one year. The construction phase will follow the design and may take several more years to complete for all of the areas at the Site.

Comment: Most of the pipelines should be four feet deep.

EPA Response: Comment noted.

Comment: The trees and all of the vegetation that is there now, a lot of that will be bulldozed over, or pulled out?

EPA Response: Yes, for the areas where the remedy includes removal of the impacted soil or sediment, or the placement of a cap, the existing vegetation will also be removed. This will be only done in certain selected areas with a medium high or high probability of ecological toxicity. Other areas, for example parts of the Molasses Bayou wetland, will be addressed by Monitored Natural Recovery. Monitored Natural Recovery depends on naturally occurring processes such as biological or chemical degradation, physical burial, or transport. In those areas, the vegetation will not be removed.

Comment: So, when the construction is completed, will new trees be planted or is it just going to be grass that will have to be mowed?

EPA Response: The plan for any replanting after construction will be determined as a part of the Remedial Design to be completed later. That will include the selection of any species to be planted, or whether the natural establishment of the existing vegetation in the area will be relied on. The considerations for any disturbed areas will be prevention of erosion and the establishment of habitat in the area.

Comment: When as you start hauling this material out, it's going to be contaminated. So you are going to put it in some type of a dumpster. I do not know if it has water in it, is this going to leak out on the road as

you drive down the road? Are you going to tear up the road and are you going to fix the road caused by hauling away material or by bringing in fresh material? Well, that's going to tear up the road. Which roads are you going to use, and where is the traffic going to be?

EPA Response: The transportation details have not been worked out yet, that will be done during the Remedial Design. However, provisions for dewatering the wet material will have to be implemented. The transportation of the removed material, as well as the new material brought to the Site will comply with all weight limits and other transport requirements. The water will not be allowed to leak onto the road. Any damages to the roads will have to be repaired.

Comment: If you start driving heavy equipment in there and things dry up, now you have a lot of dust, and contaminated dust may be blowing.

EPA Response: The Remedial Design will include provisions for dust control at the Site during the construction and transportation activities. Dust control methods may include covered trucks, light application of water to moisten soil surfaces, or other practices.

Comment: Are you going to damage the hurricane levy?

EPA Response: No, the hurricane levy will not be damaged. There is some excavation in Jefferson Canal adjacent to the south side of the hurricane levy, but it will not be extended into the levy.

Comment: You mentioned something about the groundwater. We have a shallow well where we are and I know that's not what you're dealing with, but I wonder how we can find out about groundwater contamination?

EPA Response: Groundwater contamination exists under the Huntsman facility. The groundwater plume is being addressed under the Corrective Action program by the Texas Commission on Environmental Quality. The Texas Commission on Environmental Quality person that is over the groundwater program for the Site is Mr. James Formby in Austin, Texas. Mr. Formby may be contacted at (512) 239-3156.

Comment: I do not know how they let those boats get parked in there, but there are boats in the Molasses Bayou that stopped the natural circulation of Molasses Bayou. And also, the Corps of Engineers, they pump spoilage. They have a spoil levy back on the east side. And that water coming out there, discharge water, had solids in it and it stopped the flow going to the river from there. That should be cleaned back up or dug back out where that would be a natural circulating bayou again like it was until about 15 years ago. I hope they do something about that.

EPA Response: The Molasses Bayou is an open water channel except for the portion that is silted in and no longer contains standing water. This silted area is in the northern end of the Molasses Bayou near the Neches River. Historical aerial photographs indicate that this silted in portion was historically an open water channel. However, this area of the Molasses Bayou does not have any unacceptable risk and there is no need or plans to conduct any remedial activities in or near that area. You may wish to contact the Corps of Engineers directly regarding the Molasses Bayou.

Comment: Where is all of the contaminated material going to go and how and what happens to it? Could it be sent to another state?

EPA Response: The material that is to be excavated and removed from the Site will be transported and disposed of at an approved, appropriate off-site disposal facility. The sediment from many of the Site areas will require dewatering prior to disposal. The actual location of the disposal facility will be determined during the Remedial Design, and may or may not be in another state.

Comment: You mentioned the whole concept of ecological risk, but if you take off 12 inches has anybody figured out how many animals in the mud that is going to kill?

EPA Response: The excavation of the sediment will destroy the existing habitat and likely a large number of various animals living in those areas. The decision to dig up a marsh is always a difficult one because of the damage that is created in an effort to clean up the contamination. The areas to be excavated are generally the most contaminated ones with the highest probability of toxicity and the most impact on the ecology. Not all of the contaminated areas will be excavated and removed. For example, many the contaminated areas in the Molasses Bayou and Molasses Bayou Wetland will be addressed by Monitored Natural Recovery, which will leave the existing habitat intact. These areas have ecological risk, but generally not to the same level as the areas where the remediation, consisting of either excavation and/or the installation of a cap, will result in damage to the habitat.

Comment: The Jefferson County Drainage District #7 (DD #7) is responsible for operation and maintenance of the Port Arthur Texas hurricane flood protection levee project. Sediment has accumulated at the weir of the levee pump station as well as at the levee underflow structure in Jefferson Canal (the "forebay area"). The DD #7 is concerned that future sediment buildup in the area could not be removed with dredging given the possibility of contaminating the area further. The Galveston District of the U.S. Army Corps of Engineers has indicated their concern regarding the storage capacity of the forebay ponding area and will expect that DD #7 either restore the ponding area to its full capacity or to add to the pump station capacity at great expense. The DD #7 has significant concerns that if the EPA's proposed remedy for Jefferson Canal is not amended to call for concrete lining, it will be financially prohibitive and environmentally risky for DD #7 to control the drainage and address the inevitable future sediment build-up at the pump station weir and underflow structures given the potential contamination impacts of dredging in those areas. The DD #7 requests that EPA reconsider the Proposed Plan for the Jefferson Canal to incorporate a concrete lining of the entire length of the canal from State Highway 366 to the levee underflow structure, approximately 2000 feet. The concrete lining will allow for increased runoff and will enhance DD #7's ability to maintain and remove the sediment buildup.

In addition, the proposed remediation for the Jefferson County Spoil Pile area involves removal of the spoil mounds and placement of a 2-foot thick composite cap. Elevating this area by a minimum of 2-feet will decrease the overall capacity of the ponding area. As a part of its agreement with the Corps, DD #7 is required to *"prevent any encroachment on the ponding areas which would reduce their ponding capacities, unless such reduction is offset by additional pumping capacity provided at no cost to the United States."* If EPA allows the additional 2 feet of fill to be placed in the ponding area, then DD #7 must be reimbursed for the cost to increase the pumping capacity of the pump station. Given the report received from the Corps, it is critical for the citizens that fund DD #7 that the dredging recommended and revision of the proposed plan for the Jefferson County Spoil Pile be implemented so as to avoid the significant additional costs of adding capacity to the pump station.

EPA Response: The EPA has reconsidered the Proposed Plan preferred alternatives for the Jefferson Canal and the Jefferson Spoil Pile areas in light of the comments received from DD #7.

Regarding the Jefferson Canal area, the DD #7 recommendation includes a provision for concrete lining the Jefferson Canal from Hwy 366 to the hurricane levee, approximately 2000 feet. Only part of this area is contaminated at levels higher that the remediation goals, and most of the length has been determined to not have an unacceptable risk. Therefore the EPA has no reason to implement a remedy of any kind for most of the length. The forebay area does have an unacceptable risk and therefore requires remediation. This area will require maintenance dredging, and the concern has been raised about the impact future dredging may have regarding the spread of deeper contamination. However, a review of the sampling results from this area indicate that the material deeper than one foot in the forebay area does not result in an unacceptable risk. Therefore, the selected remedial action for Jefferson Canal remains unchanged.

Regarding the impact of adding a 2-foot cover over the Jefferson Canal Spoil pile area, the EPA acknowledges that any reduced storage capacity that may result is not a reasonable outcome. Therefore, an additional criteria will be added to the selected remedy to require that the construction of the remedy in the spoil pile area will not result in a reduction in the hydraulic /storage capacity of the area consistent with the requirements and conditions of the U.S. Army Corps of Engineers, so that the storage and drainage performance of the area will not be detrimentally impacted by the selected remedy. The remedy will still be protective, and the removal of the spoil piles included in the selected remedy will aid in maintaining or improving the storage capacity.

FIGURES

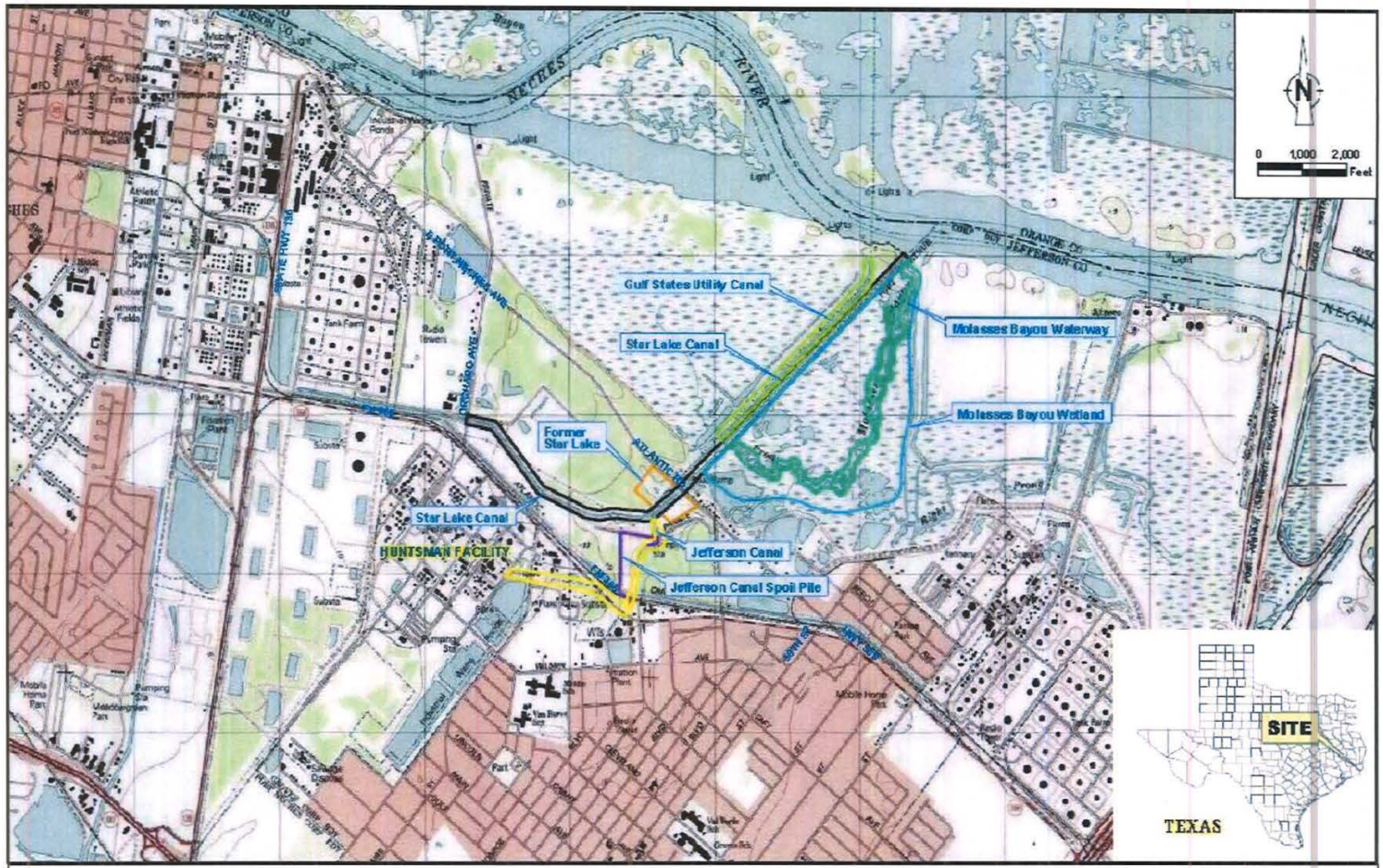


Figure 1 **Area Map, Star Lake Canal Superfund Site, Jefferson County, Texas**

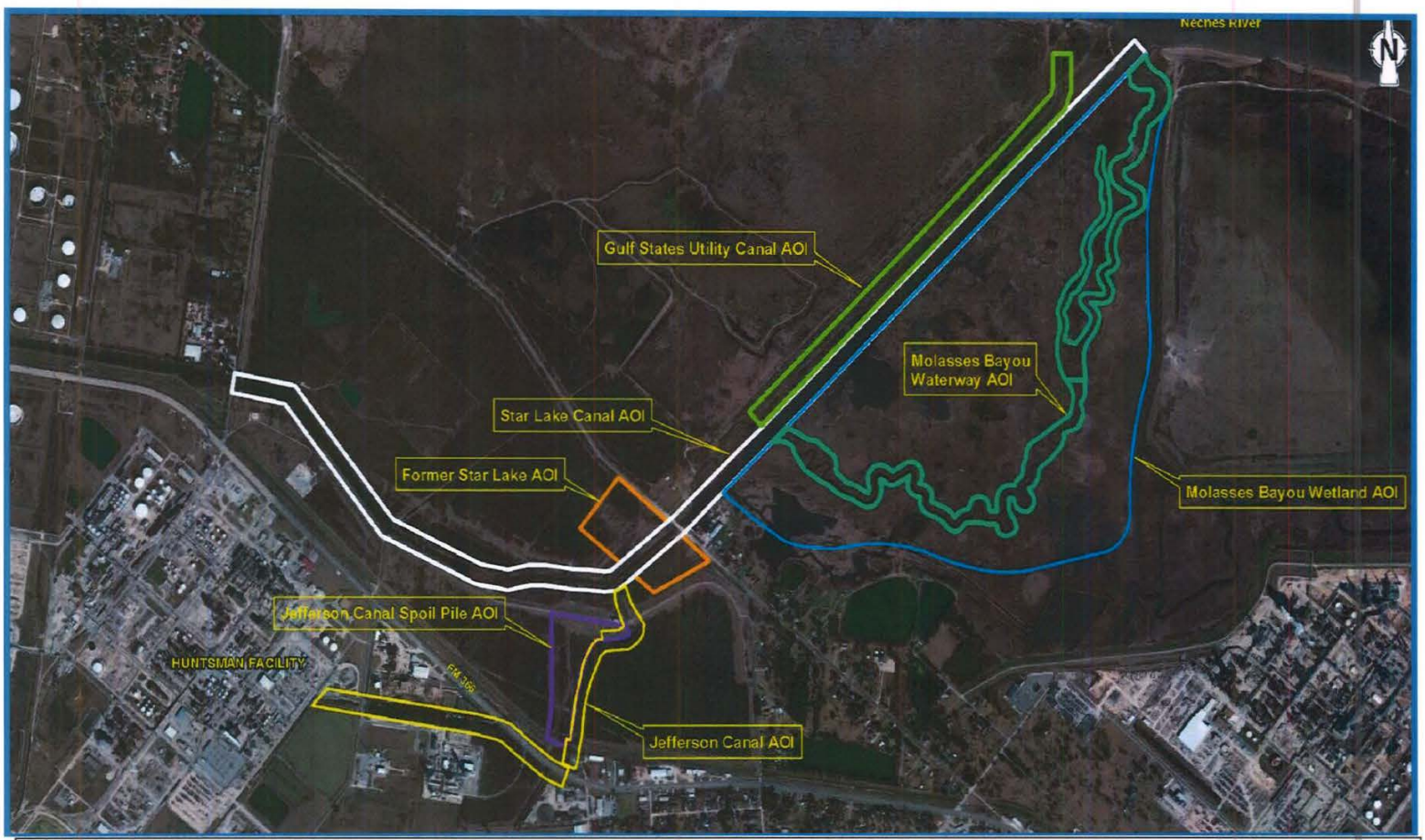


Figure 2 **Areas of Investigation, Star Lake Canal Superfund Site, Jefferson County, Texas**

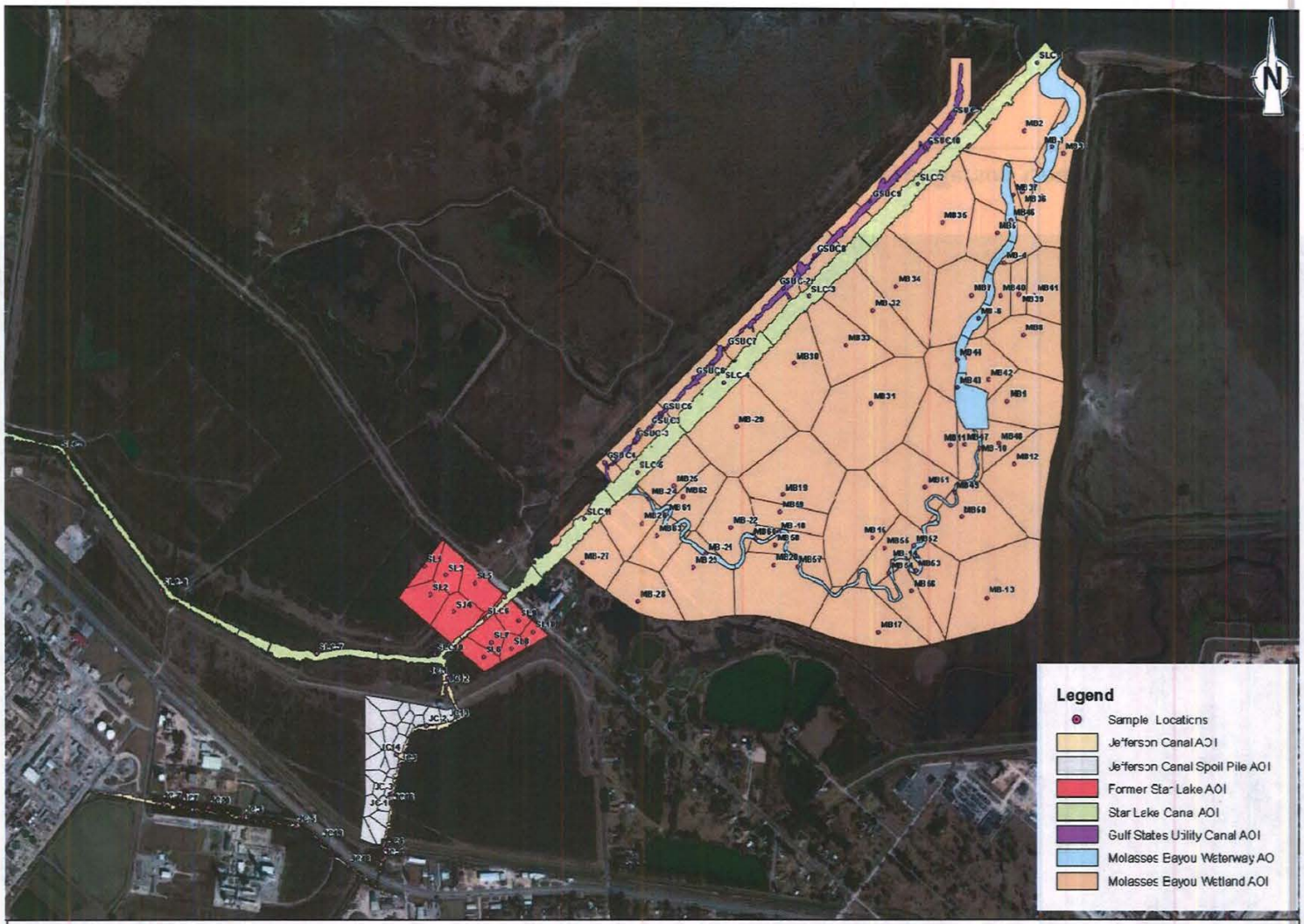


Figure 3 **Thiessen Polygons, Star Lake Canal Superfund Site, Jefferson County, Texas**

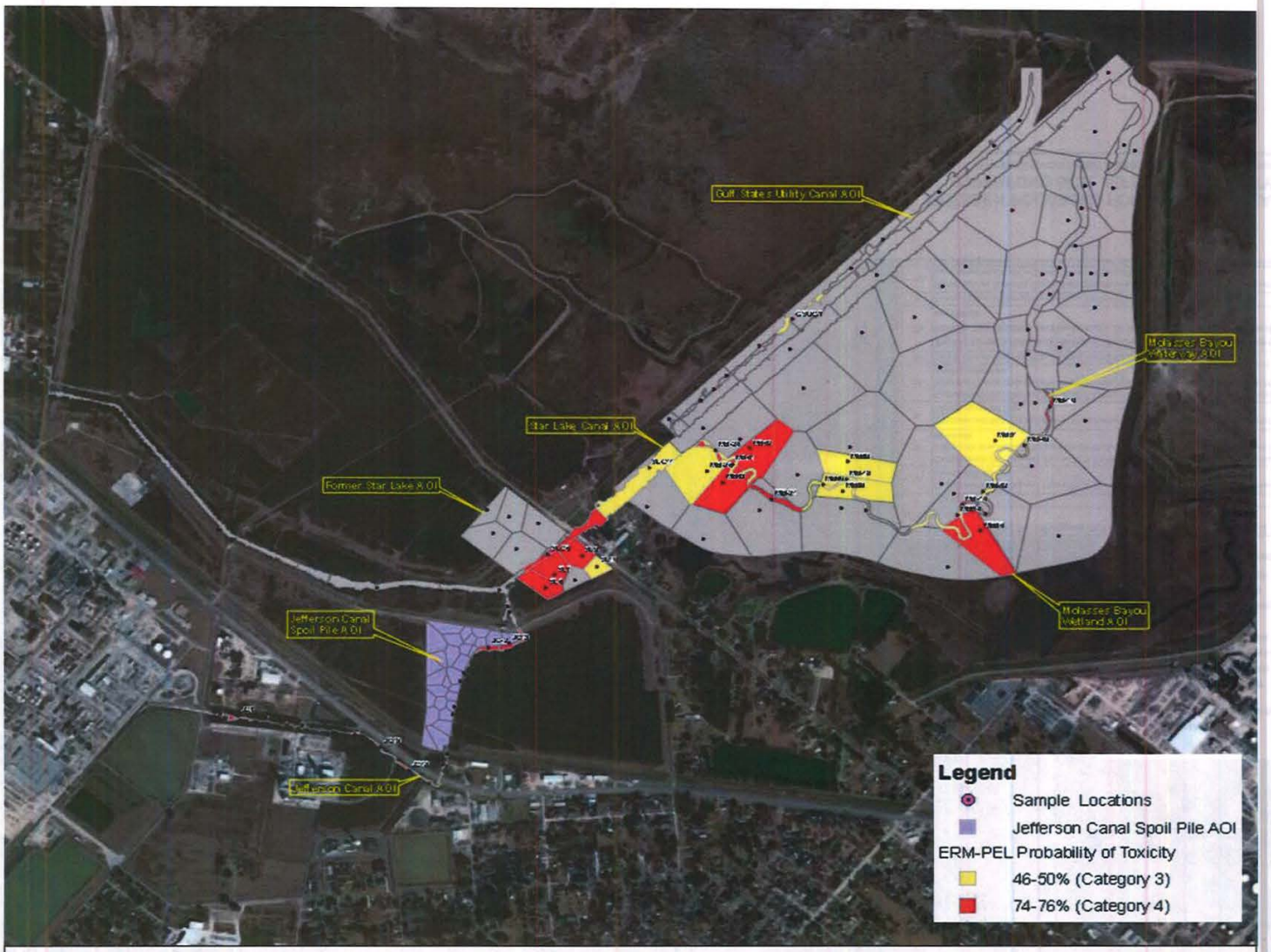


Figure 4 **Thiessen Polygons With Medium High Or High Ecological Risk Chance**

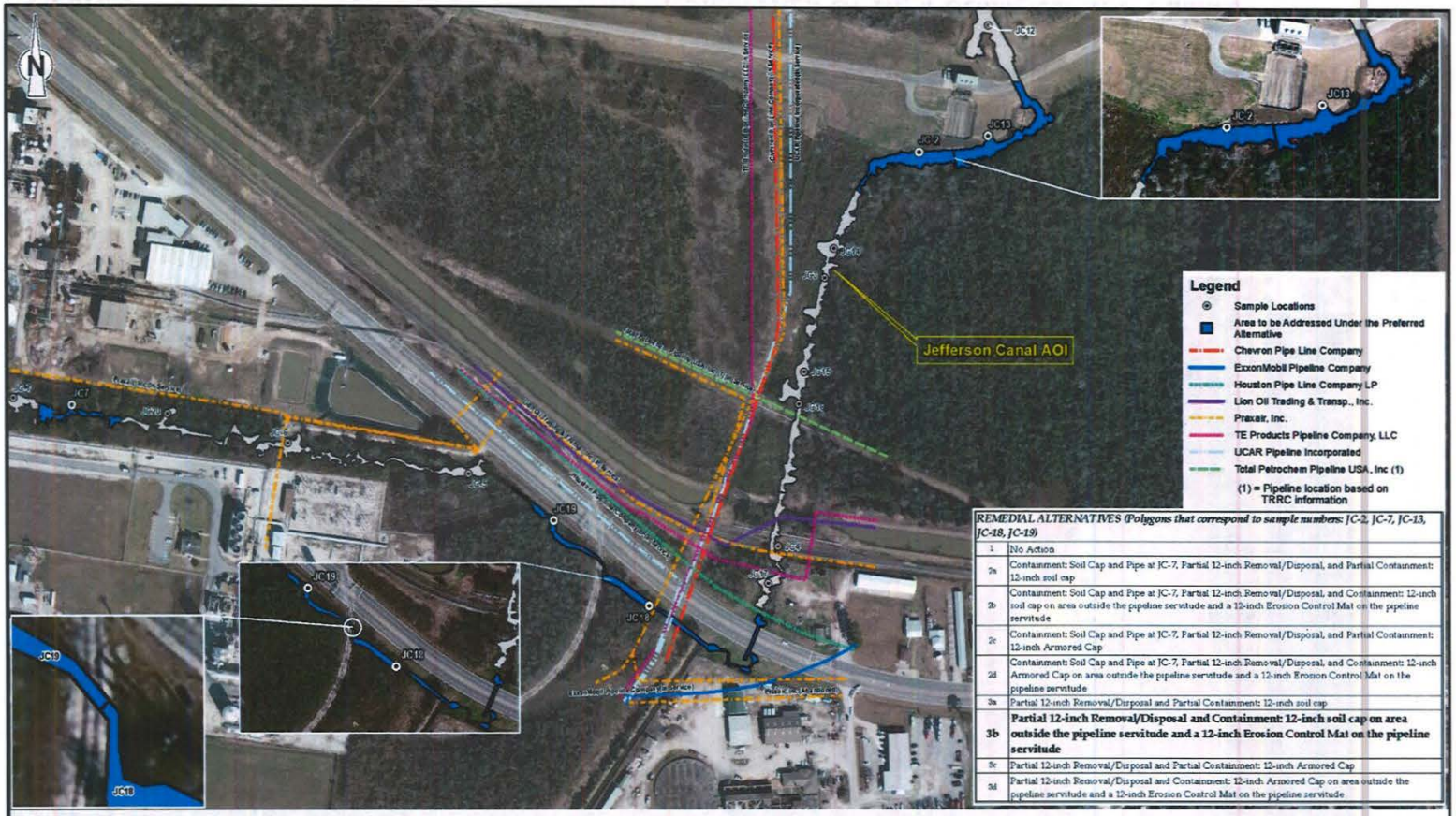
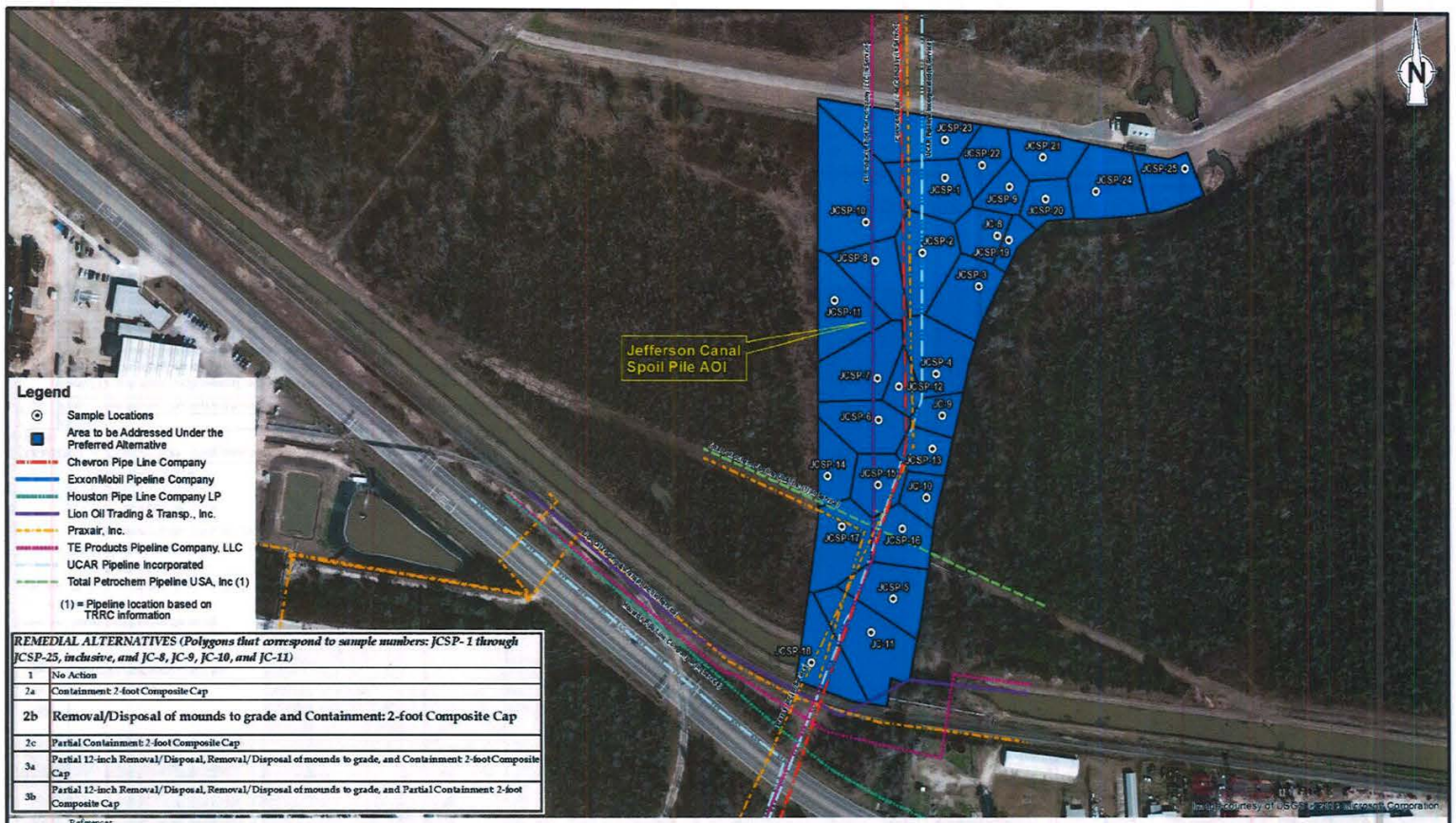


Figure 5
THIESSEN POLYGONS FOR JEFFERSON CANAL AOI
STAR LAKE CANAL SUPERFUND SITE, JEFFERSON COUNTY, TEXAS
Chevron Environmental Management Company, Houston, Texas



REMEDIAL ALTERNATIVES (Polygons that correspond to sample numbers: JCSP- 1 through JCSP-25, inclusive, and JC-8, JC-9, JC-10, and JC-11)	
1	No Action
2a	Containment: 2-foot Composite Cap
2b	**Removal/Disposal of mounds to grade and Containment: 2-foot Composite Cap**
2c	Partial Containment: 2-foot Composite Cap
3a	Partial 12-inch Removal/Disposal, Removal/Disposal of mounds to grade, and Containment: 2-foot Composite Cap
3b	Partial 12-inch Removal/Disposal, Removal/Disposal of mounds to grade, and Partial Containment: 2-foot Composite Cap

References:
2010 Aerial by Microsoft Corp and its data suppliers. Pipeline data obtained from the Texas Railroad Commission (TRRC) pipeline data set dated 2009, additional pipeline information provided by Huntsman, and site visits

Notes:
Refer to Appendix B to view pipelines at or near every Area of Investigation (AOI)
The TRRC pipeline data set dated 2009 showed 3 additional pipelines (2 Total Petrochem Pipeline USA, Inc. pipelines and 1 Air Products, LLC pipeline) that extend east to west through the northern portion of the Jefferson Canal Spoil Pile AOI. However, Huntsman confirmed that these pipelines do not exist at these locations on Site and these 3 pipelines are not shown on this map
Bold text indicates Preferred Remedial Alternative

0 100 200 Feet

27545-00(019)PR-BR023 12/20/2012

Figure 6
THIESSEN POLYGONS FOR JEFFERSON CANAL SPOIL PILE AOI
STAR LAKE CANAL SUPERFUND SITE, JEFFERSON COUNTY, TEXAS
Chevron Environmental Management Company, Houston, Texas

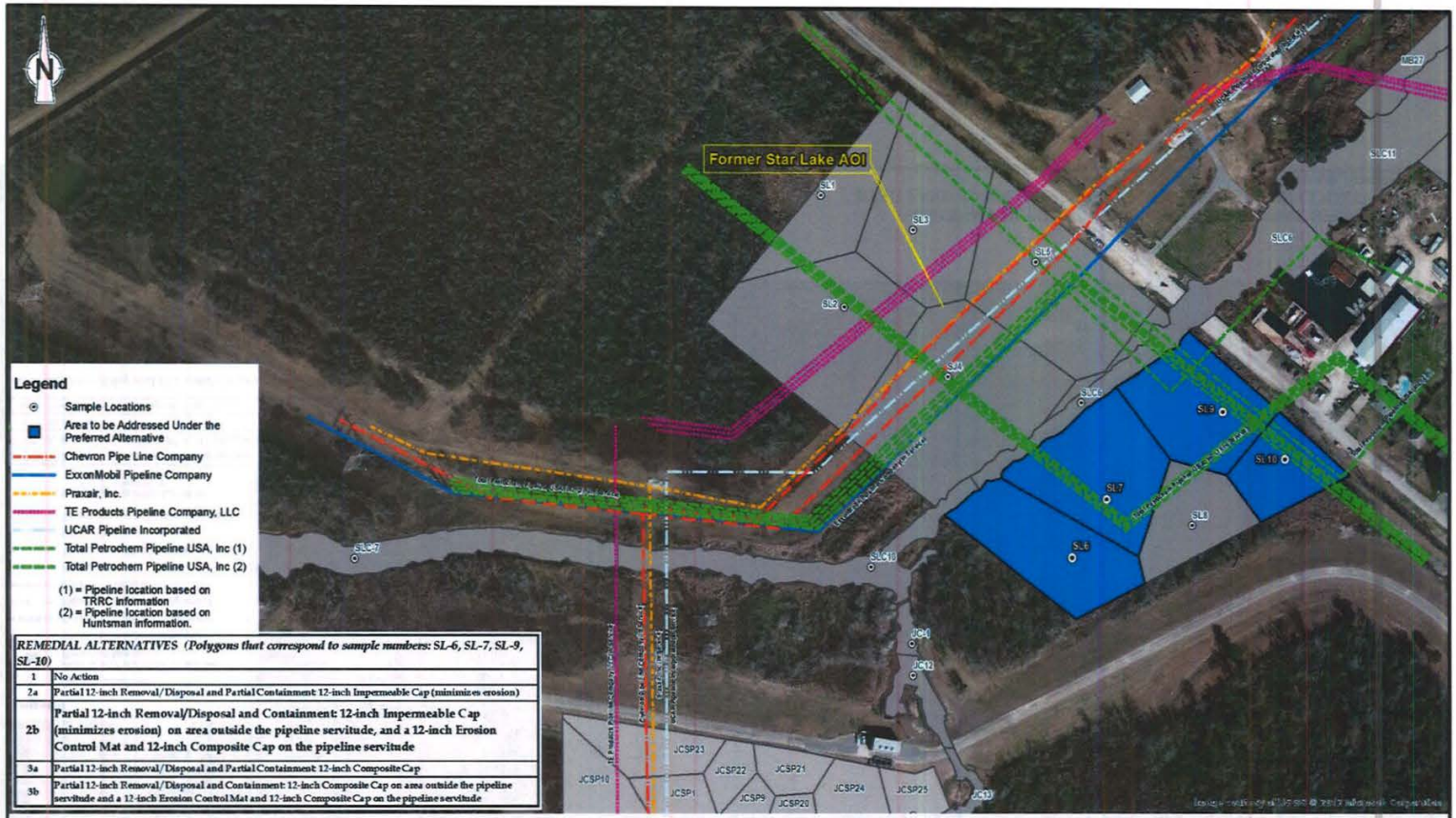
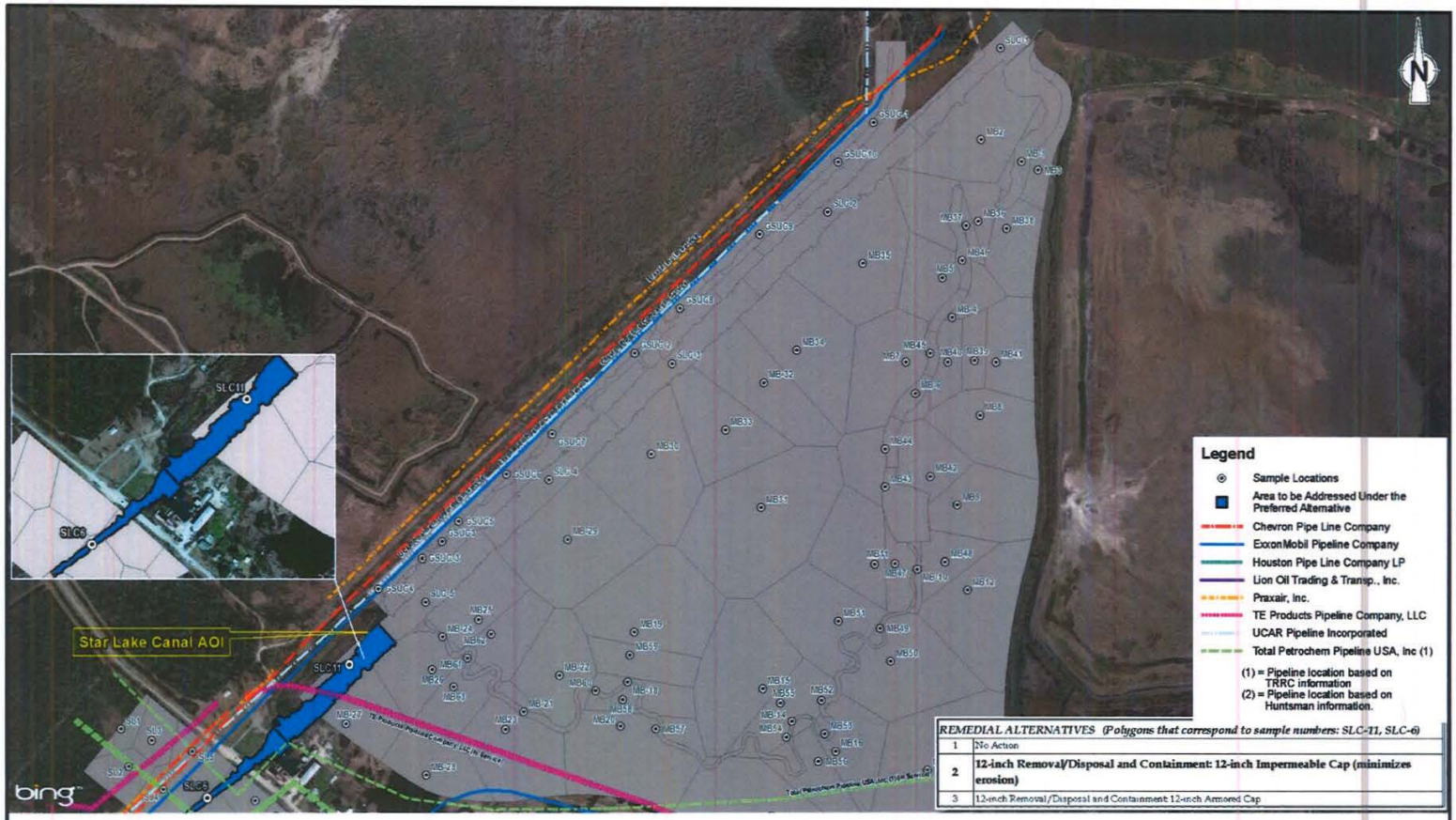


Figure 7
THIESSEN POLYGONS FOR FORMER STAR LAKE AOI
STAR LAKE CANAL SUPERFUND SITE, JEFFERSON COUNTY, TEXAS
Chevron Environmental Management Company, Houston, Texas



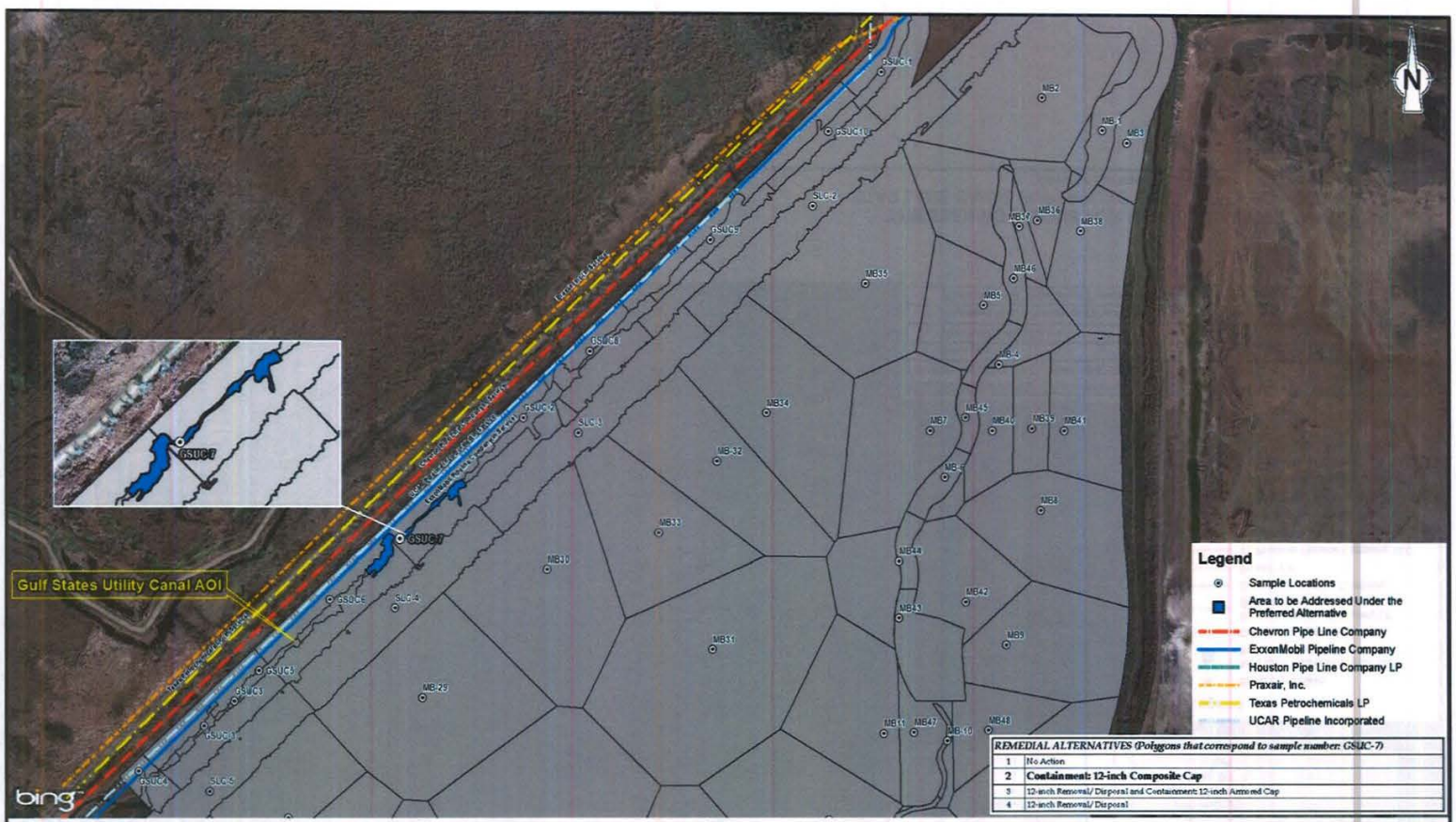
References:
2010 Aerial by Microsoft Corp and its data suppliers. Pipeline data obtained from the Texas Railroad Commission (TRRC) pipeline data set dated 2009, additional pipeline information provided by Huntsman, and site visit. Huntsman drawing no. F-Z-15-514 and F-Z-15-515.

Note:
Refer to Appendix B to view pipelines at or near every Area of Investigation (AOI).
Bold text indicates Preferred Remedial Alternative.

0 300 600 Feet

Figure 8
THIESSEN POLYGONS FOR STAR LAKE CANAL AOI
STAR LAKE CANAL SUPERFUND SITE, JEFFERSON COUNTY, TEXAS
Chevron Environmental Management Company, Houston, Texas

27545-00(019)PR-BR025 12/20/2012

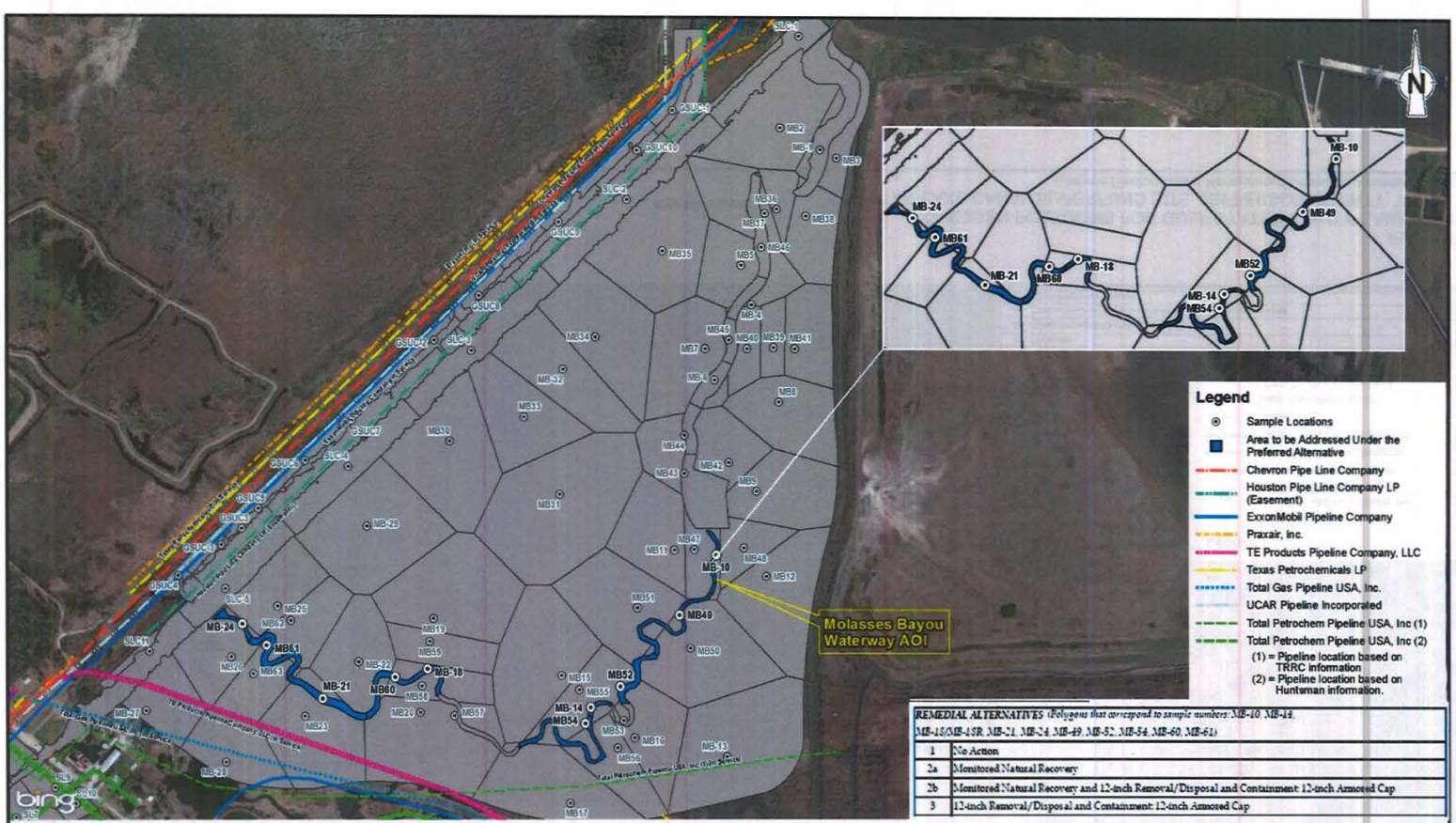


References:
2010 Aerial by Microsoft Corp and its data suppliers. Pipeline data obtained from the Texas Railroad Commission (TRRC) pipeline data set dated 2009, additional pipeline information provided by Huntsman, and site visit. Huntsman drawing no. F-Z-15-514 and F-Z-15-515.

Note:
Refer to Appendix B to view pipelines at or near every Area of Investigation (AOI).
Bold text indicates Preferred Remedial Alternative.

27545-00(019)PR-BR026 12/20/2012

Figure 9
THIESSEN POLYGONS FOR GULF STATES UTILITY CANAL AOI
STAR LAKE CANAL SUPERFUND SITE, JEFFERSON COUNTY, TEXAS
Chevron Environmental Management Company, Houston, Texas



REMEDIAL ALTERNATIVES (Polygons that correspond to sample numbers: MB-10, MB-14, MB-15/MB-15R, MB-21, MB-24, MB-49, MB-52, MB-54, MB-60, MB-61)

1	No Action
2a	Monitored Natural Recovery
2b	Monitored Natural Recovery and 12-inch Removal/Disposal and Containment: 12-inch Armored Cap
3	12-inch Removal/Disposal and Containment: 12-inch Armored Cap

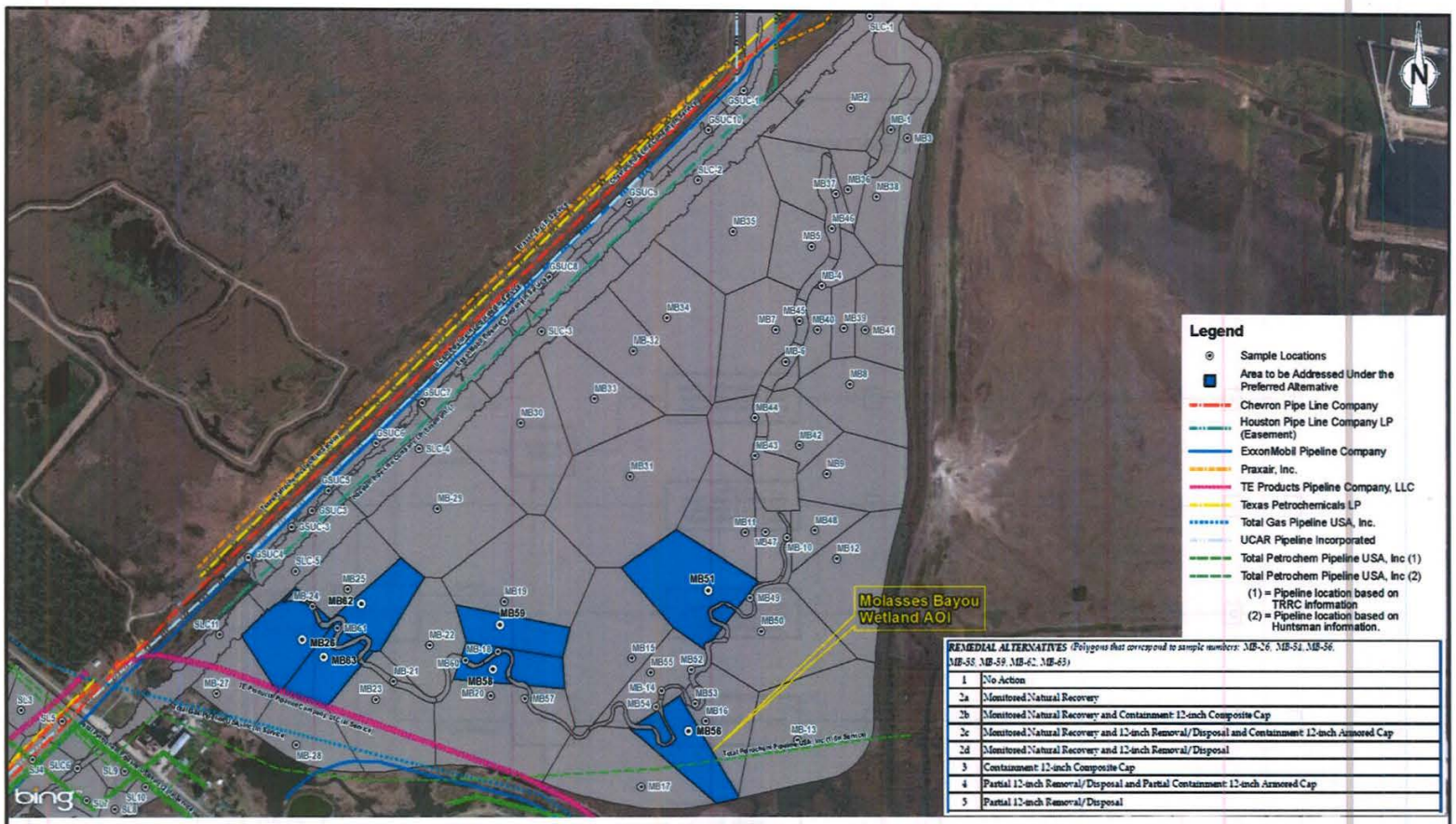
References:
2010 Aerial by Microsoft Corp and its data suppliers. Pipeline data obtained from the Texas Railroad Commission (TRRC) pipeline data set dated 2009, additional pipeline information provided by Huntsman, and site visit. Huntsman drawing no. F-Z-15-514 and F-Z-15-515.

Note:
Refer to Appendix B to view pipelines at or near every Area of Investigation (AOI).
Bold text indicates Preferred Remedial Alternative.

0 300 600 Feet

Figure 10
THIESSEN POLYGONS FOR MOLASSES BAYOU WATERWAY AOI
STAR LAKE CANAL SUPERFUND SITE, JEFFERSON COUNTY, TEXAS
Chevron Environmental Management Company, Houston, Texas

27545-00(019)PR-BR027 12/27/2012



References:
2010 Aerial by Microsoft Corp and its data suppliers. Pipeline data obtained from the Texas Railroad Commission (TRRC) pipeline data set dated 2009, additional pipeline information provided by Huntsman, and site visit. Huntsman drawing no. F-Z-15-514 and F-Z-15-515.

Note:
Refer to Appendix B to view pipelines at or near every Area of Investigation (AOI).
Bold text indicates Preferred Remedial Alternative.

27545-00(019)PR-BR028 12/27/2012

Figure 11
THIESSEN POLYGONS FOR MOLASSES BAYOU WETLAND AOI
STAR LAKE CANAL SUPERFUND SITE, JEFFERSON COUNTY, TEXAS
Chevron Environmental Management Company, Houston, Texas

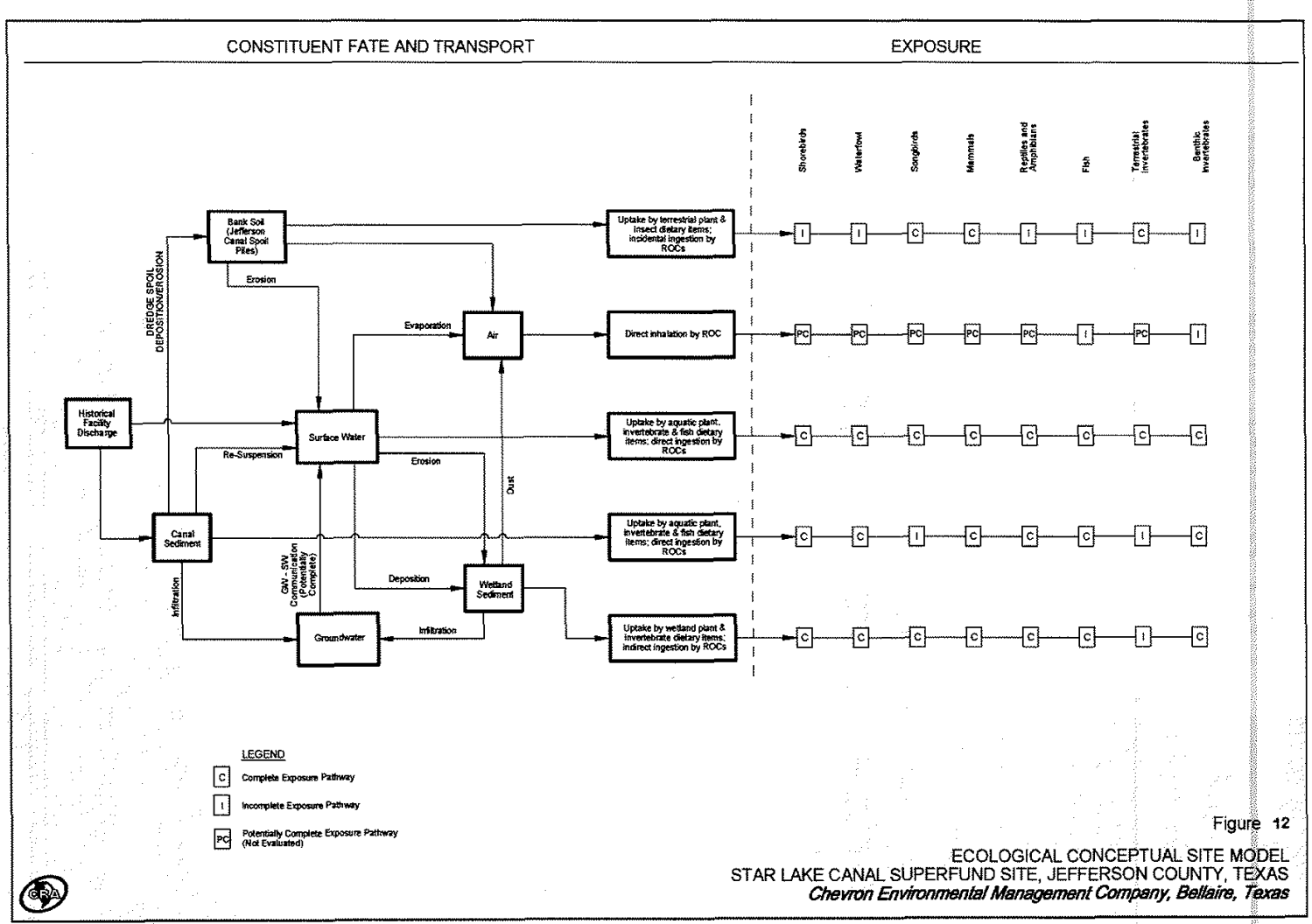


Figure 12

ECOLOGICAL CONCEPTUAL SITE MODEL
STAR LAKE CANAL SUPERFUND SITE, JEFFERSON COUNTY, TEXAS
Chevron Environmental Management Company, Bellaire, Texas

027545-00(014)GN-BR018 SEPT 10/2010

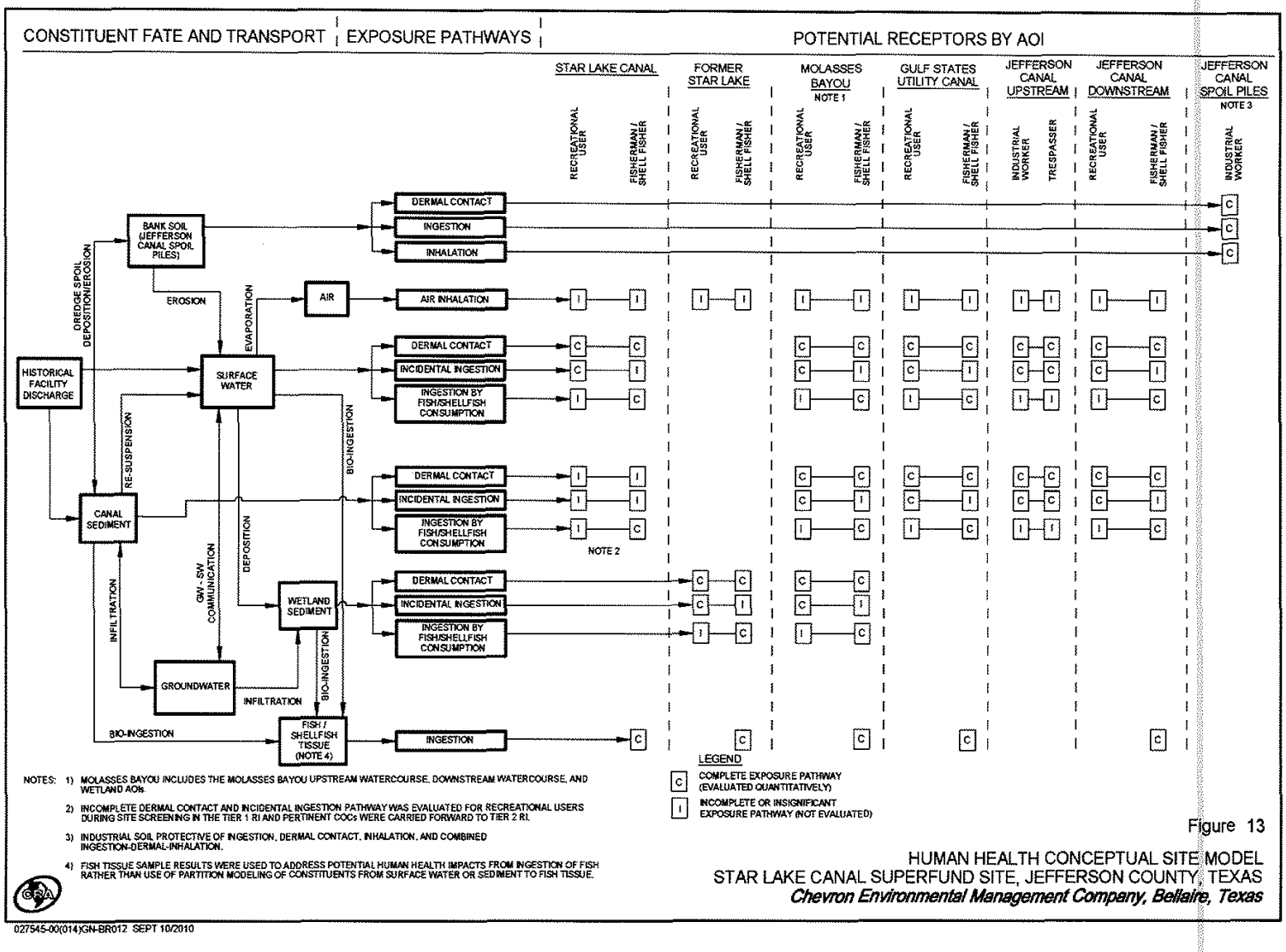
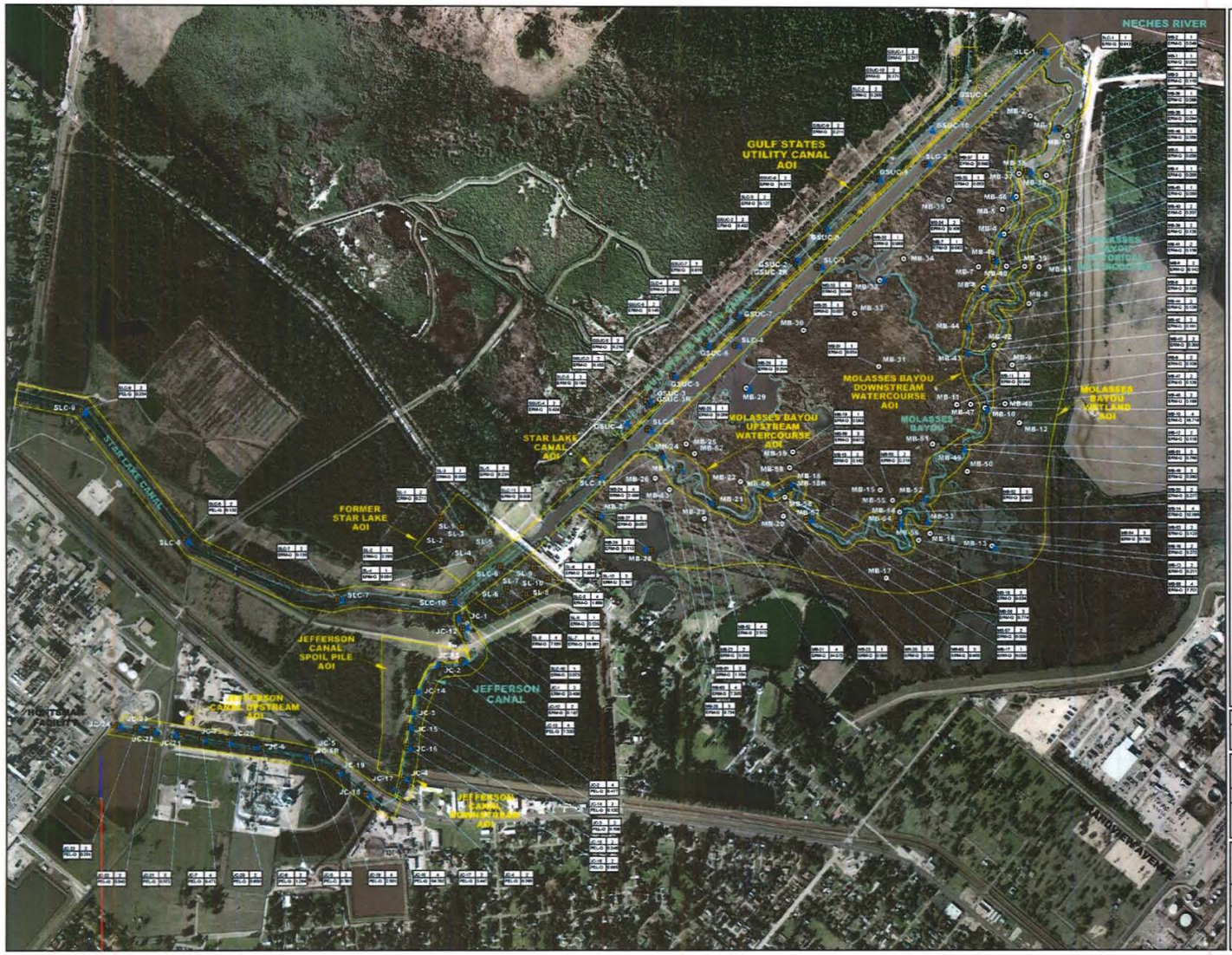


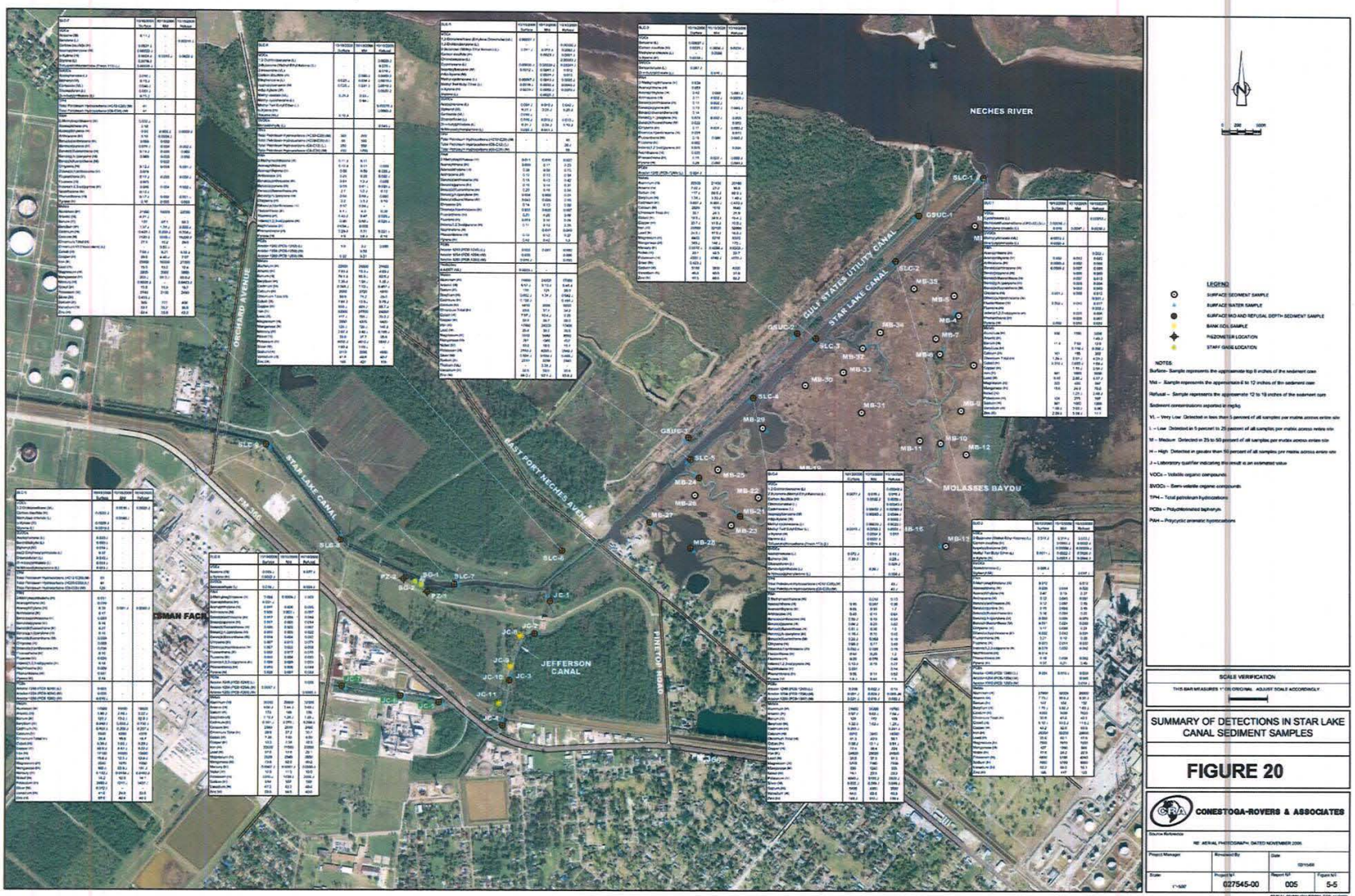
Figure 13

HUMAN HEALTH CONCEPTUAL SITE MODEL
STAR LAKE CANAL SUPERFUND SITE, JEFFERSON COUNTY, TEXAS
Chevron Environmental Management Company, Bellaire, Texas

027545-00(014)GN-BR012 SEPT 10/2010


NECHES RIVER
GULF STATES UTILITY CANAL AOI
MOLASSES BAYOU DOWNSTREAM WATERCOURSE AOI
MOLASSES BAYOU UPSTREAM WATERCOURSE AOI
MOLASSES BAYOU WETLAND AOI
STAR LAKE CANAL AOI
FORMER STAR LAKE AOI
JEFFERSON CANAL SPOIL PILE AOI
JEFFERSON CANAL UPSTREAM AOI
JEFFERSON CANAL
JEFFERSON CANAL DOWNSTREAM AOI
STAR LAKE CANAL
MOLASSES BAYOU
LEGEND
NOTES:
ERM-Q = EFFECTS RANGE MEDIAN QUOTIENT
PEL-Q = PROBABLE EFFECTS LEVEL QUOTIENT
SCALE VERIFICATION
SURFACE SEDIMENT ECOLOGICAL MEAN ERM AND PEL QUOTIENTS
Figure 17
CONESTOGA-ROVERS & ASSOCIATES
027545-00
016


NECHES RIVER
EAST PORT NECHES AVENUE
ATLANTIC ROAD
STAR LAKE CANAL
HUNTSMAN FACILITY
JEFFERSON CANAL
PINETOP ROAD
MOLASSES BAYOU
SLC-1
CSUC-1
MB-2
MB-3
SLC-2
MB-35
MB-4
MB-7
CSUC-2
MB-6
MB-5
SLC-4
MB-29
MB-9
CSUC-3
MB-10
MB-11
MB-12
SLC-5
MB-25
MB-19
MB-24
MB-22
MB-18
MB-15
MB-26
MB-21
MB-14
MB-27
MB-23
MB-20
MB-16
MB-28
MB-13
SLC-6
SLC-3
SLC-7
SC-1
FZ-2
SC-2
PZ-1
JC-1
JC-2
JC-4
JC-5
JC-10
JC-3
JC-11
JC-12
LEGEND
SURFACE SEDIMENT SAMPLE
SURFACE WATER SAMPLE
SURFACE MID AND REFUSAL DEPTH SEDIMENT SAMPLE
BANK SOIL SAMPLE
PIEZOMETER LOCATION
STAFF GAGE LOCATION
NOTES:
Surface - Sample represents the approximate top 6 inches of the sediment core
Mid – Sample represents the approximate 6 to 12 inches of the sediment core
Refusal – Sample represents the approximate 12 to 18 inches of the sediment core
Surface water concentrations reported in ug/L
VL – Very Low Detected in less than 5 percent of all samples per matrix across entire site
L – Low Detected in 5 percent to 25 percent of all samples per matrix across entire site
M – Medium Detected in 25 to 50 percent of all samples per matrix across entire site
H – High Detected in greater than 50 percent of all samples per matrix across entire site
J – Laboratory qualifier indicating the result is an estimated value
JN – Laboratory qualifier indicating the result is presumptively present at estimated value
VOCs – Volatile organic compounds
SVOCs – Semi-volatile organic compounds
TPH – Total petroleum hydrocarbons
PCBs – Polychlorinated biphenyls
PAH – Polycyclic aromatic hydrocarbons
SCALE VERIFICATION
THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY
SUMMARY OF DETECTIONS IN JEFFERSON CANAL SURFACE WATER SAMPLES
FIGURE 19
CONESTOGA-ROVERS & ASSOCIATES
Source Reference
RE: AERIAL PHOTOGRAPH, DATED NOVEMBER 2005.
Project Manager
Reviewed By
Date
09/14/06
Scale
1"=328'
Project No.
027545-00
Report No.
005
Figure No.
5-2
027545-005(GIS)MXD FEB 15/2006


NECHES RIVER
GULF STATES UTILITY CANAL
STAR LAKE CANAL
EAST PORT NECHES AVENUE
ORCHARD AVENUE
PINETOP ROAD
JEFFERSON CANAL
MOLASSES BAYOU
SLC-1
SLC-2
SLC-3
SLC-4
SLC-5
SLC-6
SLC-7
SLC-8
GSUC-1
GSUC-2
GSUC-3
MB-1
MB-2
MB-3
MB-4
MB-5
MB-6
MB-7
MB-8
MB-9
MB-10
MB-11
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MB-34
MB-35
PZ-1
PZ-2
SC-1
SC-2
JC-1
JC-2
JC-3
JC-4
JC-5
JC-6
JC-7
JC-8
JC-9
JC-10
JC-11
LEGEND
SURFACE SEDIMENT SAMPLE
SURFACE WATER SAMPLE
SURFACE MID AND REFUSAL DEPTH SEDIMENT SAMPLE
BANK SOIL SAMPLE
PIEZOMETER LOCATION
STAFF GAGE LOCATION
NOTES:
Surface- Sample represents the approximate top 6 inches of the sediment core
Mid – Sample represents the approximate 6 to 12 inches of the sediment core
Refusal – Sample represents the approximate 12 to 18 inches of the sediment core
Sediment concentrations reported in mg/kg
VL – Very Low: Detected in less than 5 percent of all samples per metre across entire site
L – Low: Detected in 5 percent to 25 percent of all samples per metre across entire site
M – Medium: Detected in 25 to 50 percent of all samples per metre across entire site
H – High: Detected in greater than 50 percent of all samples per metre across entire site
J – Laboratory qualifier indicating the result is an estimated value
VOCs – Volatile organic compounds
SVOCs – Semi-volatile organic compounds
TPH – Total petroleum hydrocarbons
PCBs – Polychlorinated biphenyls
PAH – Polycyclic aromatic hydrocarbons
SCALE VERIFICATION
THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY
SUMMARY OF DETECTIONS IN STAR LAKE CANAL SEDIMENT SAMPLES
FIGURE 20
CONESTOGA-ROVERS & ASSOCIATES
Source Reference:
RE: AERIAL PHOTOGRAPH, DATED NOVEMBER 2006
Project Manager
Reviewed By
Date
02/11/09
Scale:
1":500'
Project No.
027545-00
Report No.
005
Figure No.
5-5

TABLES

Table 1: Remedial Goals			
	Freshwater Sediment mg/kg (dry wt.)	Saltwater Sediment mg/kg (dry wt.)	Soil mg/kg (dry wt.)
Antimony	1	0.075	1
Arsenic	4.895	4.1	5.9
Cadmium	0.495	0.6	32
Chromium Total	21.7	40.5	30
Chromium VI	2.71	0.25	37
Copper	15.8	17	15
Lead	17.9	23.4	15
Mercury	0.18	0.15	Nr[1]
Selenium	0.15	0.5	0.3
Silver	1	1	nr
Vanadium	25	28.5	50
Zinc	121	150	nr
Dibenzofuran	0.315	3.5	nr
4,4'-DDE	0.00316	0.00207	nr
4,4'-DDT	0.00416	0.00119	nr
Dieldrin	0.0019	0.000715	nr
Endosulfan II	0.007	0.007	0.00001
Pentachlorophenol	25	3.99	5
Carbon disulfide	0.06	0.06	0.941
Ethylbenzene	1.43	0.325	0.03
Total PAH	0.81	2.01	1
Total PCBs (Aroclors)	0.0598	0.0227	nr

Not Required – concentration does not result in unacceptable risk.

Table 2: Summary of Sediment Data

Constituent	Saltwater First Effect Level Sediment Benchmark (mg/kg)	Mean of Detected Values, Saltwater Sediment (mg/kg)	RME Saltwater Sediment (mg/kg) B	HQ Saltwater Sediment	Freshwater First Effect Level Sediment Benchmark (mg/kg)	Mean of Detected Values, Freshwater Sediment (mg/kg)	RME, Freshwater Sediment (mg/kg) B	HQ, RME, Freshwater Sediment
Antimony	-	2.868	3.016	-	2	-	5.08~/ 2.26*	**2.54**
Arsenic	8.2	7.867	8.037	**0.98**	**9.79**	12.62	16.7	**1.71**
Cadmium	1.2	0.741	0.459	**0.38**	**0.99**	0.598	**0.59**	**0.60**
Chromium	81	92.24	138.2	**1.71**	43.4	40.05	45.51	**1.05**
Chromium VI (Hexavalent)	-	11.23	7.043	-	-	-	9.0*	-
Copper	34	94.87	113	**3.32**	31.6	196.2	357.4	11.31
Lead	46.7	108.8	140.4	**3.01**	35.8	45.4	57.14	**1.60**
Mercury	**0.15**	**0.36**	0.477	**3.18**	**0.18**	0.0839	0.117	**0.65**
Selenium	-	**6.39**	11.5	-	-	-	7.22~/ 2.67*	-
Silver	1	1.332	**0.91**	**0.91**	1	1.747	2.089	**2.09**
Vanadium	-	59.94	63.08	-	-	58.38	71.91	-
Zinc	150	125.7	140.8	**0.94**	121	166.6	238.8	**1.97**
Aroclor-1016	-	-	1.0~	-	0.007	-	2.5~	357.14
Aroclor-1221	-	-	1.0~/ 0.00982*	-	-	-	3.9~	-
Aroclor-1232	-	-	1.0~	-	-	-	2.5~	-
Aroclor-1242	-	0.784	0.747	-	-	0.378	0.369	-
Aroclor-1248	-	0.296	0.114	-	**0.03**	4.719	2.764	92.13
Aroclor-1254	-	0.362	0.288	-	**0.06**	**0.79**	0.821	13.68
Aroclor-1260	-	**0.11**	0.0963	-	0.005	0.148	0.115	23.00
4,4'-DDE	-	0.0273	0.0125	-	-	-	0.47*	-
4,4'-DDT	-	0.012	0.016	-	-	-	0.069~	-
Dieldrin	0.000715	0.0138	**0.02**	27.97	0.0019	0.118	0.105	55.26
Endosulfan II	-	-	1.8~	-	-	-	0.069~	-
Endosulfan sulfate	-	0.00435	0.00202	-	-	-	0.069~	-
Pentachlorophenol	-	**0.81**	0.598	-	0.504	**23.76**	21.3	**42.26**
2-Methylnaphthalene	**0.07**	3.032	4.782	**68.31**	-	0.3	0.757	-
Acenaphthene	0.016	2.988	4.775	**298.44**	0.0067	4.503	**11.81**	**1762.69**
Acenaphthylene	0.044	**3.04**	4.542	**103.23**	0.0059	7.012	**17.98**	**3047.46**
Anthracene	0.0853	2.057	3.463	**40.60**	0.0572	4.671	**26.98**	**471.68**
Benzo(a)anthracene	0.261	1.122	1.613	**6.18**	0.108	2.551	**4.92**	**45.56**
Benzo(a)pyrene	**0.43**	**0.95**	**1.43**	**3.33**	**0.15**	1.831	3.268	**21.79**
Benzo(b)fluoranthene	-	0.773	1.039	-	-	1.001	2.342	-
Benzo(e)pyrene	-	**0.73**	2.498	-	-	1.383	4.3	-
Benzo(g,h,i)perylene	-	0.329	0.341	-	-	0.349	0.818	-
Benzo(k)fluoranthene	-	0.457	0.508	-	-	1.135	1.471	-
Chrysene	0.384	1.199	1.849	**4.82**	0.166	2.539	4.915	**29.61**
Dibenz(a,h)anthracene	0.0634	0.124	0.167	**2.63**	0.033	0.164	0.224	**6.79**
Fluoranthene	0.6	2.172	4.693	**7.82**	0.423	4.812	**9.18**	**21.70**
Fluorene	0.019	2.583	4.138	**217.79**	0.0774	0.741	0.869	**11.23**
Indeno(1,2,3-cd)pyrene	-	0.296	0.333	-	-	0.319	**0.76**	-
Naphthalene	**0.16**	3.709	5.121	**32.01**	0.176	0.215	0.456	**2.59**
Perylene	-	0.169	0.328	-	0.204	0.347	0.917	**4.50**
Phenanthrene	**0.24**	6.1	**10.98**	**45.75**	-	**15.64**	**52.43**	-
Pyrene	0.665	4	6.574	**9.89**	0.195	10.3	**28.36**	**145.44**
Total PAH	4.022	**43.41**	**89.45**	**22.24**	**1.61**	17.8	**67.75**	**42.08**
Carbon disulfide	-	0.0115	0.0163	-	0.12	0.0109	0.0128	0.11
Ethylbenzene	0.65	0.238	0.0808	0.12	2.86	0.156	0.177	0.06

Notes:
The RME (reasonable maximum exposure) is the 95% UCL unless specified as * or ~
For hazard ratio calculations, measured methyl mercury concentrations were converted from nanograms per gram (ng/g) to milligrams per kilogram (mg/kg).
*RME is representative of the maximum detected concentration.
~The RME is representative of the maximum sample quantitation limit (SQL) . In cases when the maximum SQL is higher than the maximum detected value, the maximum SQL was compared to the appropriate benchmark as a conservative determination of the Hazard Ratio.

TABLE 3 - HAZARD QUOTIENTS FOR RECEPTORS OF CONCERN

COPECS	*Raccoon*			*Muskrat*			*Short-tailed shrew*		
	HQ [NOAEL]	*HQ [LOAEL]*	*HQ [GMATC]*	*HQ [NOAEL]*	*HQ [LOAEL]*	*HQ [GMATC]*	*HQ [NOAEL]*	*HQ [LOAEL]*	*HQ [GMATC]*
VOCs									
Carbon Disulfide	9.80E-03	1.96E-03	4.38E-03	1.51E-03	3.02E-04	6.76E-04	1.31E-02	2.63E-03	5.86E-03
Ethylbenzene	3.19E-03	6.38E-04	1.43E-03	9.28E-05	1.86E-05	4.15E-05	6.47E-03	1.29E-03	2.89E-03
SVOCs									
Dibenzofuran	1.39E-02	2.78E-03	6.22E-03	9.57E-05	1.91E-05	4.28E-05	7.69E-03	1.54E-03	3.44E-03
Pentachlorophenol	**6.28E+01**	**1.26E+01**	**2.81E+01**	2.45E-01	4.91E-02	1.10E-01	**7.89E+01**	**1.58E+01**	**3.53E+01**
PAHs									
Total PAHs	**1.02E+01**	2.23E-02	4.77E-01	**2.00E+00**	3.99E-01	8.93E-01	**5.80E+01**	**1.19E+01**	**2.62E+01**
PCBs									
Total PCBs	2.30E-01	4.90E-02	–	8.60E-02	1.80E-02	–	5.90E-01	1.30E-01	–
Pesticides									
4,4'-DDE	3.00E-03	6.00E-04	1.34E-03	8.70E-04	1.74E-04	3.89E-04	2.76E-03	5.52E-04	1.23E-03
4,4'-DDT	4.87E-03	9.75E-04	2.18E-03	2.61E-03	5.22E-04	1.17E-03	1.69E-02	3.38E-03	7.55E-03
Dieldrin	4.30E-03	8.61E-04	1.93E-03	3.66E-03	7.31E-04	1.64E-03	6.59E-02	1.32E-02	2.95E-02
Endosulfan II	**2.87E+00**	5.74E-01	**1.28E+00**	7.31E-02	1.46E-02	3.27E-02	5.41E-01	1.08E-01	2.42E-01
Metals									
Antimony	6.93E-02	1.39E-02	3.10E-02	1.93E-01	3.87E-02	8.65E-02	**1.23E+00**	2.46E-01	5.50E-01
Arsenic	1.77E-01	3.54E-02	7.92E-02	2.19E-01	4.38E-02	9.79E-02	4.62E-01	9.23E-02	2.06E-01
Cadmium	6.53E-02	1.31E-02	2.92E-02	1.55E-01	3.09E-02	6.92E-02	2.17E-01	4.35E-02	9.72E-02
Chromium Total	1.89E-01	3.78E-02	8.45E-02	4.27E-02	8.53E-03	1.91E-02	4.73E-02	9.47E-03	2.12E-02
Chromium VI	**4.01E+00**	8.02E-01	**1.79E+00**	**1.13E+01**	**2.26E+00**	**5.05E+00**	4.75E-01	9.59E-02	2.13E-01
Copper	5.42E-01	1.08E-01	2.43E-01	4.71E-01	9.42E-02	2.11E-01	4.87E-01	9.73E-02	2.18E-01
Lead	**1.12E+00**	2.25E-01	5.03E-01	2.28E-01	4.56E-02	1.02E-01	**5.83E+00**	**1.17E+00**	**2.61E+00**
Mercury	6.52E-02	1.30E-02	2.91E-02	6.06E-03	1.21E-03	2.71E-03	3.87E-03	7.74E-04	1.73E-03
Selenium	**2.84E+01**	5.67E+00	**1.27E+01**	**2.65E+01**	5.31E+00	**1.19E+01**	6.33E+00	**1.27E+00**	**2.83E+00**
Silver	5.69E-03	1.14E-03	2.55E-03	1.04E-02	2.08E-03	4.65E-03	2.02E-03	4.04E-04	9.03E-04
Vanadium	**7.25E+00**	**1.45E+00**	**3.24E+00**	**1.41E+00**	2.82E-01	6.31E-01	**4.16E+00**	**2.08E+00**	**2.94E+00**
Zinc	1.98E-01	3.96E-02	8.86E-02	2.90E-01	5.80E-02	1.30E-01	5.76E-01	1.15E-01	2.58E-01

TABLE 3 (Continued): HAZARD QUOTIENTS FOR RECEPTORS OF CONCERN

COPECS	*American robin*			*Belted kingfisher*			*Brown pelican*		
	HQ [NOAEL]	*HQ [LOAEL]*	*HQ [GMATC]*	*HQ [NOAEL]*	*HQ [LOAEL]*	*HQ [GMATC]*	*HQ [NOAEL]*	*HQ [LOAEL]*	*HQ [GMATC]*
VOCs									
Carbon Disulfide	1.29E-01	2.58E-02	5.75E-02	1.37E-01	2.75E-02	6.14E-02	4.54E-04	9.11E-05	2.03E-04
Ethylbenzene	4.20E-02	8.40E-03	1.88E-02	1.10E-01	2.21E-02	4.94E-02	1.49E-04	2.97E-05	6.64E-05
SVOCs									
Dibenzofuran	3.49E-02	6.97E-03	1.56E-02	3.13E-03	6.25E-04	1.40E-03	1.08E-05	2.16E-06	4.82E-06
Pentachlorophen	4.69E-02	9.37E-03	2.10E-02	3.47E-02	6.95E-03	1.55E-02	1.15E-04	2.30E-05	5.13E-05
PAHs									
Total PAHs	4.17E-02	8.35E-03	1.87E-02	4.55E-02	9.09E-03	2.03E-02	1.42E-04	2.83E-05	6.33E-05
PCBs									
Total PCBs	9.00E-02	2.30E-02	--	7.80E-03	2.00E-03	--	1.20E-04	3.00E-05	--
Pesticides									
4,4'-DDE	7.27E-02	1.45E-02	3.25E-02	7.47E-03	1.49E-03	3.34E-03	5.63E-06	1.13E-06	2.52E-06
4,4'-DDT	6.15E-03	1.23E-03	2.75E-03	2.25E-04	4.50E-05	1.01E-04	2.38E-06	4.77E-07	1.07E-06
Dieldrin	5.43E-02	1.09E-02	2.43E-02	1.05E-01	2.10E-02	4.70E-02	3.13E-04	6.26E-05	1.40E-04
Endosulfan II	3.49E-01	6.98E-02	1.56E-01	7.37E-01	1.47E-01	3.29E-01	1.36E-03	2.72E-04	6.09E-04
Metals									
Antimony	**1.82E+01**	**3.63E+00**	**8.12E+00**	**9.98E+00**	**2.00E+00**	**4.46E+00**	3.34E-02	6.67E-03	1.49E-02
Arsenic	1.84E-01	3.67E-02	8.21E-02	8.11E-02	1.62E-02	3.63E-02	1.40E-03	2.81E-04	6.27E-04
Cadmium	**4.17E+00**	8.35E-01	**1.87E+00**	**1.36E+00**	2.71E-01	6.07E-01	5.63E-04	1.13E-04	2.52E-04
Chromium Total	**7.58E+00**	**1.52E+00**	**3.39E+00**	**1.37E+00**	2.74E-01	6.13E-01	5.41E-03	1.08E-03	2.42E-03
Chromium VI	**1.52E+01**	**3.03E+00**	**6.78E+00**	**3.26E+00**	6.52E-01	**1.46E+00**	3.30E-03	6.59E-04	1.47E-03
Copper	**7.56E+00**	**1.51E+00**	**3.38E+00**	**5.18E+00**	**1.04E+00**	**2.32E+00**	1.18E-03	2.35E-04	5.26E-04
Lead	**1.26E+01**	**2.52E+00**	**5.64E+00**	6.59E-01	1.32E-01	2.95E-01	1.74E-03	3.47E-04	7.77E-04
Mercury	6.15E-02	6.15E-02	1.38E-01	6.37E-02	1.27E-02	2.85E-02	3.17E-04	6.33E-05	1.42E-04
Selenium	**3.38E+00**	6.76E-01	**1.51E+00**	**1.71E+00**	3.43E-01	7.67E-01	1.20E-03	2.39E-04	5.34E-04
Silver	2.36E-01	4.71E-02	1.05E-01	1.09E-01	2.18E-02	4.87E-02	3.60E-04	7.21E-05	1.61E-04
Vanadium	**8.88E+00**	**1.78E+00**	**3.97E+00**	**1.44E+00**	2.88E-01	6.44E-01	4.30E-03	8.61E-04	1.93E-03
Zinc	8.24E-01	1.65E-01	3.68E-01	4.32E-01	8.63E-02	1.93E-01	6.23E-03	1.25E-03	2.79E-03

TABLE 3 (Continued): HAZARD QUOTIENTS FOR RECEPTORS OF CONCERN

	Green heron			*Mallard*			*Marsh wren*		
COPECS	*HQ [NOAEL]*	*HQ [LOAEL]*	*HQ [GMATC]*	*HQ [NOAEL]*	*HQ [LOAEL]*	*HQ [GMATC]*	*HQ [NOAEL]*	*HQ [LOAEL]*	*HQ [GMATC]*
VOCs									
Carbon Disulfide	1.30E-02	2.61E-03	5.83E-03	1.68E-04	3.36E-05	7.51E-05	3.75E-01	7.51E-02	1.68E-01
Ethylbenzene	2.64E-02	5.27E-03	1.18E-02	1.95E-04	3.90E-05	8.72E-05	**2.40E+00**	4.80E-01	**1.07E+00**
SVOCs									
Dibenzofuran	2.91E-04	5.83E-05	1.30E-04	2.58E-04	5.15E-05	1.15E-04	8.10E-03	1.62E-03	3.62E-03
Pentachlorophen	3.29E-03	6.59E-04	1.47E-03	8.12E-01	1.62E-01	3.63E-01	9.83E-01	1.97E-01	4.39E-01
PAHs									
Total PAHs	4.98E-03	9.96E-04	2.23E-03	2.55E-03	5.09E-04	1.14E-03	4.45E-02	8.91E-03	1.99E-02
PCBs									
Total PCBs	5.20E-04	1.30E-04	--	4.10E-04	1.00E-04	--	2.40E-02	6.00E-03	--
Pesticides									
4,4'-DDE	1.44E-04	2.88E-05	6.45E-05	5.96E-05	1.19E-05	2.67E-05	2.20E-02	4.40E-03	9.84E-03
4,4'-DDT	2.75E-05	5.49E-06	1.23E-05	1.78E-04	3.55E-05	7.94E-05	2.09E-03	4.17E-04	9.33E-04
Dieldrin	8.60E-03	1.72E-03	3.85E-03	2.09E-05	4.18E-06	9.35E-06	1.06E-01	2.12E-02	4.74E-02
Endosulfan II	5.88E-02	1.18E-02	2.63E-02	5.55E-03	1.11E-03	2.48E-03	6.71E-01	1.34E-01	3.00E-01
Metals									
Antimony	9.46E-01	1.89E-01	4.23E-01	8.50E-01	1.70E-01	3.80E-01	**2.63E+01**	**5.26E+00**	**1.18E+01**
Arsenic	1.09E-01	2.17E-02	4.85E-02	6.17E-03	1.23E-03	2.76E-03	**1.02E+00**	2.03E-01	4.55E-01
Cadmium	1.60E-02	3.19E-03	7.14E-03	2.95E-03	5.90E-04	1.32E-03	**3.57E+00**	7.14E-01	**1.60E+00**
Chromium Total	1.10E-01	2.21E-02	4.93E-02	9.83E-03	1.97E-03	4.40E-03	8.53E-01	1.71E-01	3.81E-01
Chromium VI	2.29E-01	4.58E-02	1.02E-01	5.43E-02	1.09E-02	2.43E-02	**4.36E+01**	**8.71E+00**	**1.95E+01**
Copper	5.28E-02	1.06E-02	2.36E-02	2.84E-03	5.69E-04	1.27E-03	**1.91E+01**	**3.83E+00**	**8.56E+00**
Lead	1.14E-01	2.29E-02	5.12E-02	2.14E-02	4.28E-03	9.57E-03	7.98E-01	1.60E-01	3.57E-01
Mercury	3.55E-03	7.09E-04	1.59E-03	2.14E-03	4.29E-04	9.59E-04	1.07E-01	2.13E-02	4.77E-02
Selenium	3.25E-02	6.50E-03	1.45E-02	2.94E-02	5.87E-03	1.31E-02	**4.53E+00**	9.06E-01	**2.03E+00**
Silver	1.04E-02	2.08E-03	4.64E-03	1.83E-03	3.67E-04	8.21E-04	3.02E-01	6.03E-02	1.35E-01
Vanadium	9.62E-02	1.92E-02	4.30E-02	2.15E-02	4.30E-03	9.61E-03	8.06E-01	1.61E-01	3.61E-01
Zinc	2.81E-01	5.62E-02	1.26E-01	1.65E-02	3.30E-03	7.37E-03	**1.88E+00**	3.75E-01	8.40E-01

TABLE 3 (Continued): HAZARD QUOTIENTS FOR RECEPTORS OF CONCERN

	Reddish egret			*Spotted sandpiper*			*White-faced ibis*		
COPECS	*HQ [NOAEL]*	*HQ [LOAEL]*	*HQ [GMATC]*	*HQ [NOAEL]*	*HQ [LOAEL]*	*HQ [GMATC]*	*HQ [NOAEL]*	*HQ [LOAEL]*	*HQ [GMATC]*
VOCs									
Carbon Disulfide	9.56E-03	1.92E-03	4.28E-03	**2.48E+00**	4.98E-01	**1.11E+00**	1.61E-03	3.23E-04	7.22E-04
Ethylbenzene	4.00E-03	8.00E-04	1.79E-03	**1.58E+00**	3.15E-01	7.05E-01	6.22E-02	1.24E-02	2.78E-02
SVOCs									
Dibenzofuran	2.10E-04	4.20E-05	9.40E-05	**4.57E+01**	**9.14E+00**	**2.04E+01**	5.70E-04	1.14E-04	2.55E-04
Pentachlorophen	2.38E-03	4.76E-04	1.06E-03	**1.11E+00**	2.22E-01	4.96E-01	2.41E-02	4.81E-03	1.08E-02
PAHs									
Total PAHs	3.00E-03	6.01E-04	1.34E-03	1.87E-01	3.73E-02	8.34E-02	1.52E-02	3.04E-03	6.79E-03
PCBs									
Total PCBs	1.10E-03	2.80E-04	--	9.80E-02	2.50E-02	--	4.40E-03	1.10E-03	--
Pesticides									
4,4'-DDE	1.25E-04	2.49E-05	5.57E-05	2.67E-02	5.33E-03	1.19E-02	8.40E-04	1.68E-04	3.76E-04
4,4'-DDT	9.89E-06	1.98E-06	4.42E-06	2.30E-03	4.60E-04	1.03E-03	3.20E-04	6.40E-05	1.43E-04
Dieldrin	9.90E-03	1.98E-03	4.43E-03	9.72E-02	1.94E-02	4.35E-02	5.05E-03	1.01E-03	2.26E-03
Endosulfan II	7.12E-02	1.42E-02	3.18E-02	7.81E-01	1.56E-01	3.49E-01	3.83E-02	7.67E-03	1.71E-02
Metals									
Antimony	6.83E-01	1.37E-01	3.05E-01	**2.11E+01**	**4.23E+00**	**9.45E+00**	**1.11E+00**	2.23E-01	4.98E-01
Arsenic	3.49E-02	6.98E-03	1.56E-02	6.97E-01	1.39E-01	3.12E-01	2.58E-01	5.17E-02	1.16E-01
Cadmium	1.15E-02	2.31E-03	5.16E-03	**3.12E+00**	6.24E-01	**1.40E+00**	2.97E-02	5.94E-03	1.33E-02
Chromium Total	8.22E-02	1.64E-02	3.67E-02	**2.23E+00**	4.46E-01	9.98E-01	3.90E-01	7.80E-02	1.75E-01
Chromium VI	6.75E-02	1.35E-02	3.02E-02	**1.30E+02**	**2.60E+01**	**5.81E+01**	5.71E-01	1.14E-01	2.55E-01
Copper	2.39E-02	4.78E-03	1.07E-02	**1.57E+01**	**3.14E+00**	**7.03E+00**	7.15E-02	1.43E-02	3.20E-02
Lead	1.24E-01	2.48E-02	5.55E-02	**2.71E+00**	5.42E-01	**1.21E+00**	**1.35E+00**	2.71E-01	6.06E-01
Mercury	3.44E-01	4.08E-04	9.12E-04	1.24E-01	2.48E-02	5.55E-02	1.70E-02	3.40E-03	7.60E-03
Selenium	2.39E-02	4.78E-03	1.07E-02	**3.67E+00**	7.34E-01	**1.64E+00**	3.93E-02	7.87E-03	1.76E-02
Silver	7.38E-03	1.48E-03	3.30E-03	2.46E-01	4.91E-02	1.10E-01	1.41E-02	2.82E-03	6.30E-03
Vanadium	1.14E-01	2.27E-02	5.08E-02	**2.25E+00**	4.50E-01	**1.01E+00**	4.20E-01	8.40E-02	1.88E-01
Zinc	1.79E-01	3.59E-02	8.03E-02	**1.43E+00**	2.86E-01	6.39E-01	5.01E-01	1.00E-01	2.24E-01

TABLE 3 (Continued): HAZARD QUOTIENTS FOR RECEPTORS OF CONCERN

	Wood stork			*Bullfrog*			*Painted turtle*		
COPECS	*HQ [NOAEL]*	*HQ [LOAEL]*	*HQ [GMATC]*	*HQ [NOAEL]*	*HQ [LOAEL]*	*HQ [GMATC]*	*HQ [NOAEL]*	*HQ [LOAEL]*	*HQ [GMATC]*
VOCs									
Carbon Disulfide	2.86E-02	5.74E-03	1.28E-02	5.49E-02	1.10E-02	2.46E-02	1.06E-02	2.13E-03	4.75E-03
Ethylbenzene	1.19E-02	2.37E-03	5.31E-03	8.29E-01	1.66E-01	3.71E-01	2.44E-01	4.89E-02	1.09E-01
SVOCs									
Dibenzofuran	6.20E-04	1.24E-04	2.77E-04	1.31E-02	2.61E-03	5.84E-03	4.62E-03	9.24E-04	2.07E-03
Pentachlorophen ol	7.08E-03	1.42E-03	3.16E-03	4.22E-01	8.44E-02	1.89E-01	**2.10E+00**	4.20E-01	9.39E-01
PAHs									
Total PAHs	8.99E-03	1.80E-03	4.02E-03	3.95E-02	7.90E-03	1.77E-02	1.18E-02	2.36E-03	5.28E-03
PCBs									
Total PCBs	3.30E-03	8.40E-04	–	1.00E-01	2.70E-02	–	3.70E-02	9.30E-03	–
Pesticides									
4,4'-DDE	3.61E-04	7.22E-05	1.61E-04	2.22E-03	4.44E-04	9.92E-04	5.41E-04	1.08E-04	2.42E-04
4,4'-DDT	3.22E-05	6.43E-06	1.44E-05	4.54E-03	9.09E-04	2.03E-03	1.45E-02	2.91E-03	6.50E-03
Dieldrin	2.85E-02	5.71E-03	1.28E-02	8.53E-02	1.92E-03	1.28E-02	1.17E-02	2.34E-03	5.23E-03
Endosulfan II	2.04E-01	4.09E-02	9.14E-02	4.35E-01	8.69E-02	1.94E-01	8.12E-02	1.62E-02	3.63E-02
Metals									
Antimony	**2.04E+00**	4.07E-01	9.10E-01	**4.05E+00**	8.10E-01	**1.81E+00**	**1.44E+00**	2.89E-01	6.45E-01
Arsenic	1.03E-01	2.06E-02	4.61E-02	**3.67E+00**	7.34E-01	**1.64E+00**	**1.20E+00**	2.40E-01	5.36E-01
Cadmium	6.55E-03	1.31E-03	2.93E-03	**2.20E+00**	3.99E-01	9.37E-01	7.12E-02	1.42E-02	3.18E-02
Chromium Total	2.31E-01	4.61E-02	1.03E-01	**1.04E+00**	2.07E-01	4.64E-01	2.67E-01	5.34E-02	1.19E-01
Chromium VI	1.86E-01	3.73E-02	8.33E-02	**3.92E+00**	7.84E-01	**1.75E+00**	**1.91E+00**	3.82E-01	8.53E-01
Copper	6.59E-02	1.32E-02	2.95E-02	7.25E-01	1.45E-01	3.24E-01	1.91E-01	3.81E-02	8.53E-02
Lead	3.59E-01	7.18E-02	1.60E-01	**2.24E+00**	4.47E-01	**1.00E+00**	6.96E-01	1.39E-01	3.11E-01
Mercury	6.68E-03	1.34E-03	2.99E-03	3.41E-02	6.82E-03	1.52E-02	9.49E-03	1.90E-03	4.25E-03
Selenium	6.99E-02	1.40E-02	3.13E-02	**1.40E+00**	2.80E-01	6.26E-01	4.98E-01	9.95E-02	2.23E-01
Silver	2.22E-02	4.43E-03	9.91E-03	8.73E-02	1.75E-02	3.91E-02	3.10E-02	6.20E-03	1.39E-02
Vanadium	3.28E-01	6.56E-02	1.47E-01	**1.67E+00**	3.34E-01	7.46E-01	6.69E-01	1.34E-01	2.99E-01
Zinc	5.37E-01	1.07E-01	2.40E-01	**1.91E+00**	3.82E-01	8.54E-01	5.01E-01	1.00E-01	2.24E-01

TABLE 4
PREDICTED HAZARD QUOTIENT RESULTS FOLLOWING REMEDIATION (SCENARIO 10B SENSITIVITY ANALYSIS)
STAR LAKE CANAL SUPERFUND SITE

	Raccoon			*Muskrat*			*Short-tailed shrew*			*American robin*		
Constituents	*LOAEL*	*GMATC*	*NOAEL*	*LOAEL*	*GMATC*	*NOAEL*	*LOAEL*	*GMATC*	*NOAEL*	*LOAEL*	*GMATC*	*NOAEL*
Carbon Disulfide	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN
Ethylbenzene	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN
Dibenzofuran	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN
Pentachlorophenol	7.04E-01	**1.57E+00**	**3.52E+00**	NN	NN	NN	1.28E-04	2.85E-04	6.38E-04	NN	NN	NN
Total PAHs	NN	NN	**1.04E+00**	NN	NN	**3.75E+00**	4.09E-03	9.04E-03	2.00E-02	NN	NN	NN
Endosulfan II	NN	9.86E-01	**2.20E+00**	NN	NN	NN	NN	NN	NN	NN	NN	NN
Aluminum	2.43E-01	5.43E-01	**1.21E+00**	NN	8.57E-01	**1.92E+00**	4.98E-01	**1.11E+00**	**2.49E+00**	**1.36E+00**	**3.04E+00**	**6.79E+00**
Antimony	NN	NN	NN	NN	NN	NN	NN	NN	5.75E-03	2.76E-03	6.18E-03	1.38E-02
Arsenic	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN
Cadmium	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	9.28E-04	2.07E-03
Chromium Total	NN	NN	NN	NN	NN	NN	NN	NN	NN	2.07E-03	4.63E-03	1.04E-02
Chromium VI	NN	2.47E-01	5.53E-01	3.38E-01	7.55E-01	**1.69E+00**	NN	NN	NN	3.12E-03	6.97E-03	1.56E-02
Copper	NN	NN	NN	NN	NN	NN	NN	NN	NN	1.55E-03	3.47E-03	7.75E-03
Lead	NN	NN	4.70E-02	NN	NN	NN	5.39E-03	1.21E-02	2.70E-02	9.38E-04	2.10E-03	4.69E-03
Manganese	3.55E-01	7.94E-01	**1.78E+00**	2.27E-01	5.08E-01	**1.14E+00**	NN	NN	NN	2.87E-03	6.41E-03	1.43E-02
Selenium	3.37E-01	7.54E-01	**1.69E+00**	1.83E-01	4.09E-01	9.15E-01	3.03E-03	6.77E-03	1.51E-02	NN	1.45E-03	3.25E-03
Vanadium	8.88E-02	1.98E-01	4.44E-01	NN	NN	8.03E-01	5.67E-02	8.02E-02	1.13E-01	8.91E-03	1.99E-02	4.46E-02

Notes:
Scenario 10b = Remediate all sediment samples with an Effects Range Median-Quotient/Probable Effects Level-Quotient (ERM-Q/PEL-Q) Score > 2 to ½ 1st effects benchmark levels, all soil to background levels, and all earthworms, terrestrial plants and insects set to a zero concentration.
Italicized values indicate the modified risk evaluations
Bold values indicate a Hazard Quotient (HQ) >1
NN = Not Needed - indicates risk was acceptable at the Site, therefore evaluation in the Sensitivity Analysis was not necessary
NOAEL = No Observed Adverse Effects Level
LOAEL = Low Observed Adverse Effects Level
GMATC = Geometric Maximum Allowable Toxicant Concentration

TABLE 4 (Continued)
PREDICTED HAZARD QUOTIENT RESULTS FOLLOWING REMEDIATION (SCENARIO 10B SENSITIVITY ANALYSIS)
STAR LAKE CANAL SUPERFUND SITE

	White-faced ibis			*Wood stork*			*Bullfrog*			*Painted turtle*		
Constituents	*LOAEL*	*GMATC*	*NOAEL*	*LOAEL*	*GMATC*	*NOAEL*	*LOAEL*	*GMATC*	*NOAEL*	*LOAEL*	*GMATC*	*NOAEL*
Carbon Disulfide	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN
Ethylbenzene	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN
Dibenzofuran	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN
Pentachlorophenol	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	5.70E-02
Total PAHs	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN
Endosulfan II	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN
Aluminum	2.92E-02	6.54E-02	1.46E-01	NN	NN	1.51E+00	NN	**1.54E+00**	**3.44E+00**	NN	1.25E+00	**2.79E+00**
Antimony	NN	NN	1.26E-01	NN	NN	3.93E-01	NN	3.53E-01	7.90E-01	NN	NN	3.28E-01
Arsenic	NN	NN	NN	NN	NN	NN	NN	9.43E-01	**2.11E+00**	NN	NN	8.87E-01
Cadmium	NN	NN	NN	NN	NN	NN	NN	NN	**3.02E+00**	NN	NN	NN
Chromium Total	NN	NN	NN	NN	NN	NN	NN	NN	4.44E-01	NN	NN	NN
Chromium VI	NN	NN	NN	NN	NN	NN	NN	**2.69E+00**	**6.02E+00**	NN	NN	6.18E-01
Copper	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN
Lead	NN	NN	3.75E-02	NN	NN	NN	NN	7.02E-01	**1.57E+00**	NN	NN	NN
Manganese	NN	NN	NN	NN	NN	NN	4.29E-02	9.60E-02	2.15E-01	1.52E-01	3.41E-01	7.62E-01
Selenium	NN	NN	NN	NN	NN	NN	NN	NN	3.25E-01	NN	NN	NN
Vanadium	NN	NN	NN	NN	NN	NN	NN	NN	**1.23E+00**	NN	NN	NN

Notes:
Scenario 10b = Remediate all sediment samples with an Effects Range Median-Quotient/Probable Effects Level-Quotient (ERM-Q/PEL-Q) Score > 2 to ½ 1st effects benchmark levels, all soil to background levels, and all earthworms, terrestrial plants and insects set to a zero concentration.
Italicized values indicate the modified risk evaluations
Bold values indicate a Hazard Quotient (HQ) >1
NN = Not Needed - indicates risk was acceptable at the Site, therefore evaluation in the Sensitivity Analysis was not necessary
NOAEL = No Observed Adverse Effects Level
LOAEL = Low Observed Adverse Effects Level
GMATC = Geometric Maximum Allowable Toxicant Concentration

Table 4 (continued)
PREDICTED HAZARD QUOTIENT RESULTS FOLLOWING REMEDIATION (SCENARIO 10B SENSITIVITY ANALYSIS)
STAR LAKE CANAL SUPERFUND SITE

	Belted kingfisher			*Mallard*			*Marsh wren*			*Spotted sandpiper*		
Constituents	*LOAEL*	*GMATC*	*NOAEL*	*LOAEL*	*GMATC*	*NOAEL*	*LOAEL*	*GMATC*	*NOAEL*	*LOAEL*	*GMATC*	*NOAEL*
Carbon Disulfide	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	2.69E-02	6.01E-02
Ethylbenzene	NN	NN	NN	NN	NN	NN	NN	7.19E-04	1.61E-03	NN	NN	**3.91E+00**
Dibenzofuran	NN	NN	NN	NN	NN	NN	NN	NN	NN	2.39E-01	5.36E-01	**1.20E+00**
Pentachlorophenol	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	**3.94E+00**
Total PAHs	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN
Endosulfan II	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN
Aluminum	**1.47E+01**	**3.28E+01**	**7.33E+01**	NN	NN	6.17E-01	**5.10E+00**	**1.14E+01**	**2.55E+01**	**1.30E+01**	**2.91E+01**	**6.52E+01**
Antimony	3.61E-01	8.08E-01	**1.81E+00**	NN	NN	-	7.72E-03	1.73E-02	3.86E-02	1.10E-01	2.47E-01	5.52E-01
Arsenic	NN	NN	NN	NN	NN	NN	NN	NN	1.22E-03	NN	NN	NN
Cadmium	NN	NN	**1.77E+00**	NN	NN	NN	NN	5.32E-03	1.19E-02	NN	2.34E-01	5.24E-01
Chromium Total	NN	NN	6.27E-01	NN	NN	NN	NN	NN	NN	NN	NN	2.82E-01
Chromium VI	NN	**4.23E+00**	**9.47E+00**	NN	NN	NN	7.21E-03	1.61E-02	3.60E-02	4.50E-01	**1.01E+00**	**2.25E+00**
Copper	6.22E-01	**1.39E+00**	**3.11E+00**	NN	NN	NN	3.92E-02	8.77E-02	1.96E-01	6.22E-01	**1.39E+00**	**3.11E+00**
Lead	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	8.17E-02	1.83E-01
Manganese	NN	**1.49E+00**	**3.34E+00**	NN	NN	NN	NN	4.09E-02	9.14E-02	NN	9.85E-01	**2.20E+00**
Selenium	NN	NN	3.62E-01	NN	NN	NN	NN	6.14E-03	1.37E-02	NN	5.15E-02	1.15E-01
Vanadium	NN	NN	8.59E-01	NN	NN	NN	NN	NN	NN	NN	2.56E-01	5.72E-01

Notes:
Scenario 10b = Remediate all sediment samples with an Effects Range Median-Quotient/Probable Effects Level-Quotient (ERM-Q/PEL-Q) Score > 2 to ½ 1st effects benchmark levels, all soil to background levels, and all earthworms, terrestrial plants and insects set to a zero concentration.
Italicized values indicate the modified risk evaluations
Bold values indicate a Hazard Quotient (HQ) >1
NN = Not Needed - indicates risk was acceptable at the Site, therefore evaluation in the Sensitivity Analysis was not necessary
NOAEL = No Observed Adverse Effects Level
LOAEL = Low Observed Adverse Effects Level
GMATC = Geometric Maximum Allowable Toxicant Concentration

TABLE 5

CHEMICAL-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs) STAR LAKE CANAL SUPERFUND SITE JEFFERSON COUNTY, TEXAS

Statutes	*ARARs (Regulations)*	*Summary of Topics within Cited Regulations*	*Reason for retention or elimination*
Toxic Substances Control Act (TSCA)	40 CFR 761	Disposal of Polychlorinated Biphenyls (PCBs)	Applicable for PCB disposal for water, soil, and sediment.
Clean Water Act (CWA)	Section 404 National Pollutant Discharge Elimination System (NPDES)	Dredging, backfill, or infill materials or activities within waters and wetlands of the United States.	Applicable for waters of the United States.

TABLE 6

LOCATION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)
STAR LAKE CANAL SUPERFUND SITE
JEFFERSON COUNTY, TEXAS

Potentially Applicable Statutes	*ARARs (Regulations)*	*Summary of Topics within Cited Regulations*	*Reason for retention or elimination*
Clean Water Act (CWA)	Section 404 National Pollutant Discharge Elimination System (NPDES)	Dredging, backfill, or infill materials or activities within waters and wetlands of the United States.	Applicable for waters of the United States.
Texas Surface Water Quality Standards	30 TAC §307.6(b)(4)	The toxic criteria that apply to surface water in the state and specifically apply to substances attributed to waste discharges or human activity.	Applicable for surface water of Texas.
Floodplain Management	40 CFR Part 6 Appendix A and 40 CFR 6.302	Applicable if remedial activities occur in the floodplain	Applicable to activities taking place within a documented floodplain.
Protection of Wetlands	40 CFR Section 6.302 (a)	Applicable if remedial activities affect or impact wetlands	Applicable to activities taking place in delineated wetlands.
National Historical Preservation Act	16 USC Section 470 & 661 et seq., 36 CFR Part 65, 36 CFR Part 800	Defines procedures to preserve scientific, historical, and archaeological data from potential destruction resulting from a change in the site terrain resulting from a federal construction project or federally licensed activity. If such artifacts are discovered during work at the site, work in the area will be stopped until data recovery and preservation activities are completed in accordance with the Act and regulations.	Applicable if scientific, historical, and archaeological data is discovered during project.

Potentially Applicable Statutes	*ARARs (Regulations)*	*Summary of Topics within Cited Regulations*	*Reason for retention or elimination*
Endangered Species Act of 1973	16 USC Section 1531 et seq., 50 CFR 222-228	Federal agencies must confirm any action that is federally authorized, funded, or implemented by the agency is not probable to adversely affect the continued existence of any threatened or endangered species. The agency must ensure that the critical habitat is not destroyed or negatively modified.	Applicable if threatened or endangered species are found on-site.
Texas Parks and Wildlife Department	31 TAC §65.171 - 65.176.	Requirements for any species of wildlife listed in Texas as threatened or endangered, living or dead, including parts.	Applicable if Texas threatened or endangered species are found on-site.
Rivers and Harbors Act of 1899	Section 10 (33 USC Section 401 et. seq.), 33 CFR 322	Approval from the U.S. Army Corps of Engineers is generally required when altering the course, location, condition, or capacity of the channel of any navigable water of the United States by excavating or filling.	Applicable for areas that excavation and capping are proposed.
Fish and Wildlife Coordination Act	16 U.S.C. Section 662	When modifications to a stream or other water body are proposed or approved by any United States agency, such agency shall review with the United States Fish and Wildlife Service, Department of the Interior, and with the head of the agency overseeing the wildlife resources of the Site.	Applicable for areas that excavation and capping are proposed.

TABLE 7

ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)
STAR LAKE CANAL SUPERFUND SITE
JEFFERSON COUNTY, TEXAS

Potentially Applicable Statutes	*ARARs (Regulations)*	*Summary of Topics within Cited Regulations*	*Reason for retention or elimination*
Resource Conservation and Recovery Act (RCRA)	40 CFR 260, 261, 262, 263, 264, 268, 270, 271, 272, 370	General Hazardous Waste Management including identification, generation, transportation, disposal of waste; Permitting, monitoring, and reporting requirements; authorization and recognition of Sate Hazardous Waste Programs; chemical release reporting	Applicable for transportation and disposal of hazardous waste as defined by RCRA (listed or based on characteristics).
Toxic Substances Control Act (TSCA)	40 CFR 761	Disposal of polychlorinated biphenyls (PCBs)	Applicable disposal for water, soil, and sediment impacted by PCBs.
Clean Water Act (CWA)	Section 404 National Pollutant Discharge Elimination System (NPDES)	Dredging, backfill, or infill materials or activities within waters and wetlands of the United States.	Applicable for waters of the United States.
Hazardous Material Transportation Act	49 CFR 107, 171-177	Regulates transportation of hazardous materials.	Applies to off-Site disposal activities of soil and sediment considered hazardous materials as defined in Section 172.101.
Industrial Solid Waste And Municipal Hazardous Waste – Transporter Standards	30 TAC §335.91	Standards for transporters transporting hazardous waste to off-site storage, processing, or disposal facilities.	Applies to off-Site disposal activities of soil and sediment considered hazardous waste.

APPENDIX A

Prepared for

United States Environmental Protection Agency

Region 6

RECORD OF DECISION
ADMINISTRATIVE RECORD INDEX

for

STAR LAKE CANAL
SUPERFUND SITE

EPA ID No. TX0001414341
SSID:06GY

EP-W-10-011
Task Order No. EP-DTO6-00002

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Remedial Project Manager
U.S. EPA Region 6

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April 2, 2014

PREAMBLE

The purpose of this document is to provide the public with an index to the Administrative Record File (AR File) for the U.S. Environmental Protection Agency's (EPA) selected remedial action to respond to conditions at the Star Lake Canal Superfund Site (the "Site"). EPA's action is authorized by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. Section 9601 et seq.

Section 113 (j)(1) of CERCLA, 42 U.S.C. Section 9613 (j)(1), provides that judicial review of the adequacy of a CERCLA response action shall be limited to the Administrative Record (AR). Section 113 (k)(1) of CERCLA, 42 U.S.C. Section 9613 (k)(1), requires the EPA to establish an AR upon which it shall base the selection of its remedial actions. As the EPA decides what to do at the site of a release of hazardous substances, it compiles documents concerning the site and its decision into an "AR File." This means that documents may be added to the AR File from time to time. After the EPA Regional Administrator or the Administrator's delegate signs the Action Memorandum or the Record of Decision memorializing the selection of the action, the documents which form the basis for the selection of the response action are then known as the Administrative Record "AR."

Section 113(k)(1) of CERCLA requires the EPA to make the AR File available to the public at or near the site of the response action. Accordingly, the EPA has established a repository where the AR File may be reviewed near the Site at:

Effie & Wilton Hebert Public Library
2025 Merriman
Port Neches, Texas 77651
(409) 722-4554

and

Texas Commission on Environmental Quality
Records Management Center
12100 Park 35 Circle
Building E, 1st Floor
Austin, Texas 78753
Contact: John Flores
Telephone: 1-800-633-9363

The public also may review the AR File at the EPA Region 6 office in Dallas, Texas, by contacting the Remedial Project Manager at the address listed below. The AR File is available for public review during normal business hours. The AR File is treated as a non-circulating reference document. Any document in the AR File may be photocopied according to the procedures used at the repository or at the EPA Region 6 office. This index and the AR File were compiled in accordance with the EPA's Final Guidance on Administrative Records for Selecting CERCLA Response Actions, Office of Solid Waste and Emergency Response (OSWER) Directive Number 9833.3A1 (December 3, 1990).

Documents listed as bibliographic sources for other documents in the AR File might not be listed separately in the index. Where a document is listed in the index but not located among the documents which the EPA has made available in the repository, the EPA may, upon request, include the document in the repository or make the document available for review at an alternate location. This applies to documents such as verified sampling data, chain of custody forms, guidance and policy documents, as well as voluminous site-specific reports. It does not apply to documents in EPA's confidential file. (Copies of guidance documents also can be obtained by calling the RCRA/Superfund/Title 3 Hotline at (800) 424-9346.)

These requests should be addressed to:

Gary Miller
Remedial Project Manager
U.S. EPA Region 6
1445 Ross Avenue
Dallas, Texas 75202-2733
(214) 665-8318

The EPA response selection guidance compendium index has not been updated since March 22, 1991 (see CERCLA Administrative Records: First Update of the Compendium of Documents Used for Selecting CERCLA Response Actions [March 22, 1991]); accordingly, it is not included here. Moreover, based on resource considerations, the Region 6 Superfund Division Director has decided not to maintain a Region 6 compendium of response selection guidance. Instead, consistent with 40 CFR Section 300.805(a)(2) and 300.810(a)(2) and OSWER Directive No. 9833.3A-1 (page 37), the AR File Index includes listings of all guidance documents which may form a basis for the selection of the response action in question.

The documents included in the AR File index are arranged predominantly in chronological order. The AR File index helps locate and retrieve documents in the file. It also provides an overview of the response action history. The index includes the following information for each document:

- **Doc ID**- The document identifier number.
- **Date** - The date the document was published and/or released. "01/01/2525" means no date was recorded.
- **Pages** - Total number of printed pages in the document, including attachments.
- **Title -** Descriptive heading of the document.
- **Document Type** - General identification, (e.g. correspondence, Remedial Investigation Report, Record of Decision.)
- **Author** - Name of originator, and the name of the organization that the author is affiliated with. If either the originator name or the organization name is not identified, then the field is captured with the letters "N/A".
- **Addressee**- Name and affiliation of the addressee. If either the originator name or the organization name is not identified, then the field is captured with the letters "N/A".

ADMINISTRATIVE RECORD INDEX

04/04/2014 **Region ID: 06**

ADMINISTRATIVE RECORD

Site Name: STAR LAKE CANAL
CERCLIS: TX0001414341
OUID:
SSID: 06GY
Action: RECORD OF DECISION

Region ID: 06
Doc ID: 920451
Bates: 000001 **To:** 000002
Date: 08/19/1983
Pages: 2
Title: INSPECTION SUMMARY OF TEXACO CHEMICAL COMPANY
Doc Type: REPORT / STUDY

	Name	Organization
Author:	NONE, NONE	TEXAS DEPARTMENT OF WATER RESOURCES

	Name	Organization
Addressee:	NONE, NONE	NONE

Region ID: 06
Doc ID: 917816
Bates: 000003 **To:** 000503
Date: 09/01/1996
Pages: 501
Title: PRELIMINARY ASSESSMENT / SCREENING SITE INSPECTION WORK PLAN
Doc Type: REPORT / STUDY

	Name	Organization
Author:	CANELLAS, BARTOLOME J	U.S. ENVIRONMENTAL PROTECTION AGENCY
	COUNTER, TODD	TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
	SEILS, ALLAN M	TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
	NEWBERRY, WESLEY G	TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
	CEDILOTE, MARSHALL A	TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

	Name	Organization
Addressee:	NONE,	NONE

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ADMINISTRATIVE RECORD

Site Name: STAR LAKE CANAL
CERCLIS: TX0001414341
OUID:
SSID: 06GY
Action: RECORD OF DECISION

Region ID: 06
Doc ID: 918374
Bates: 000504 **To:** 000969
Date: 02/06/1997
Pages: 466
Title: SCREENING SITE INSPECTION REPORT
Doc Type: REPORT / STUDY

	Name	Organization
Author:	EPPERSON, DEANNA	TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
	SEILS, ALLAN M	TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
	CANELLAS, BARTOLOME J	U.S. ENVIRONMENTAL PROTECTION AGENCY
	NEWBERRY, WESLEY G	TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
	CEDOLITE, MARSHALL	TEXAS NATURAL RESOURCES CONSERVATION COMMISSION
	Name	**Organization**
Addressee:	NONE,	NONE

Region ID: 06
Doc ID: 88407
Bates: 000970 **To:** 001232
Date: 02/01/1998
Pages: 263
Title: EXPANDED SITE INSPECTION WORK PLAN FOR THE STAR LAKE CANAL SUPERFUND SITE
Doc Type: WORK PLAN / AMENDMENT

	Name	Organization
Author:	KIRCHNER, WILLIAM	ENVIRONMENTAL PROTECTION AGENCY
	COUNTER, C T	TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
	NEWBERRY, WESLEY G	TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
	SEILS, ALLAN M	TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
	CEDILOTE, MARSHALL A	TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
	Name	**Organization**
Addressee:	NONE,	NONE

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Site Name: STAR LAKE CANAL
CERCLIS: TX0001414341
OUID:
SSID: 06GY
Action: RECORD OF DECISION

Region ID: 06
Doc ID: 105338
Bates: 001233 **To:** 002623
Date: 01/01/1999
Pages: 1391
Title: EXPANDED SITE INSPECTION REPORT FOR THE STAR LAKE CANAL SUPERFUND SITE (VOLUMES I THROUGH III OF III)
Doc Type: REPORT / STUDY

	Name	Organization
Author:	SEILS, ALLAN M	TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
	NEWBERRY, WESLEY G	TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
	RHOTENBERRY, WILLIAM	U.S. ENVIRONMENTAL PROTECTION AGENCY
	SMITH, CATRIONA V	TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
	CEDILOTE, MARSHALL A	TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

	Name	Organization
Addressee:	NONE,	NONE

Region ID: 06
Doc ID: 9216315
Bates: 002624 **To:** 002624
Date: 10/12/1999
Pages: 1
Title: EPA PUBLIC NOTICE OF INTENT TO APPLY FOR THE STAR LAKE CANAL TECHNICAL ASSISTANCE GRANT
Doc Type: NOTICE
FORM

	Name	Organization
Author:	NONE, NONE	U.S. ENVIRONMENTAL PROTECTION AGENCY

	Name	Organization
Addressee:	NONE,	NONE

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Site Name: STAR LAKE CANAL
CERCLIS: TX0001414341
OUID:
SSID: 06GY
Action: RECORD OF DECISION

Region ID: 06
Doc ID: 9216316
Bates: 002625 **To:** 002625
Date: 08/28/2000
Pages: 1
Title: EPA PUBLIC NOTICE OF PLACEMENT OF STAR LAKE CANAL ON NPL
Doc Type: NOTICE

	Name	Organization
Author:	NONE, NONE	U.S. ENVIRONMENTAL PROTECTION AGENCY
	Name	**Organization**
Addressee:	NONE,	NONE

Region ID: 06
Doc ID: 665445
Bates: 002626 **To:** 002648
Date: 12/12/2000
Pages: 23
Title: PUBLIC HEALTH ASSESSMENT FOR STAR LAKE CANAL
Doc Type: HEALTH ASSESSMENT
REPORT / STUDY
ELECTRONIC RECORD

	Name	Organization
Author:	WILLIAMS, LISA R	AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY
	Name	**Organization**
Addressee:	NONE,	NONE

Region ID: 06
Doc ID: 918810
Bates: 002649 **To:** 002650
Date: 09/04/2002
Pages: 2
Title: [FEDERAL SUPERFUND MONTHLY PROGRESS REPORT FOR THE MONTH OF AUGUST, 2002]
Doc Type: REPORT / STUDY

	Name	Organization
Author:	NONE, NONE	NONE
	Name	**Organization**
Addressee:	NONE, NONE	NONE

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Site Name: STAR LAKE CANAL
CERCLIS: TX0001414341
OUID:
SSID: 06GY
Action: RECORD OF DECISION

Region ID: 06
Doc ID: 208168
Bates: 002651 **To:** 002673
Date: 04/01/2003
Pages: 23
Title: COMMUNITY INVOLVEMENT PLAN FOR THE STAR LAKE CANAL SUPERFUND SITE
Doc Type: COMMUNITY RELATIONS PLAN

	Name	Organization
Author:	NONE,	U.S. ENVIRONMENTAL PROTECTION AGENCY
Addressee:	NONE,	NONE

Region ID: 06
Doc ID: 926098
Bates: 002674 **To:** 002696
Date: 04/01/2003
Pages: 23
Title: COMMUNITY INVOLVEMENT PLAN
Doc Type: COMMUNITY RELATIONS PLAN

	Name	Organization
Author:	NONE, NONE	U.S. ENVIRONMENTAL PROTECTION AGENCY
Addressee:	NONE, NONE	NONE

Region ID: 06
Doc ID: 926161
Bates: 002697 **To:** 002719
Date: 04/01/2003
Pages: 23
Title: FINAL STAR LAKE COMMUNITY INVOLVEMENT PLAN
Doc Type: ELECTRONIC RECORD
COMMUNITY RELATIONS PLAN

	Name	Organization
Author:	NONE, NONE	U.S. ENVIRONMENTAL PROTECTION AGENCY
Addressee:	NONE, NONE	NONE

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Site Name: STAR LAKE CANAL
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SSID: 06GY
Action: RECORD OF DECISION

Region ID: 06
Doc ID: 926162
Bates: 002720 **To:** 002720
Date: 04/14/2003
Pages: 1
Title: [TRANSMITTAL OF THE FINAL COMMUNITY INVOLVEMENT PLAN: STAR LAKE COMMUNITY RELATIONS PLAN]
Doc Type: ELECTRONIC RECORD
CORRESPONDENCE

	Name	Organization
Author:	JAMESON, LORRAINE	CH2M HILL

	Name	Organization
Addressee:	HALLIDAY, ZANA	U.S. ENVIRONMENTAL PROTECTION AGENCY
	CASANOVA, RAFAEL A	U.S. ENVIRONMENTAL PROTECTION AGENCY

Region ID: 06
Doc ID: 684975
Bates: 002721 **To:** 002789
Date: 12/22/2005
Pages: 69
Title: ADMINISTRATIVE SETTLEMENT AGREEMENT AND ORDER ON CONSENT FOR REMEDIAL INVESTIGATION/FEASIBILITY STUDY - CERCLA DOCKET NO. 06-02-06
Doc Type: CONTRACT / AGREEMENT
ELECTRONIC RECORD

	Name	Organization
Author:	HEPOLA, JOHN R	U.S. ENVIRONMENTAL PROTECTION AGENCY
	MCDANIEL, ELIZABETH E	HUNTSMAN PETROCHEMICAL CORPORATION

	Name	Organization
Addressee:	NONE,	NONE
	NONE, NONE	NONE

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Site Name: STAR LAKE CANAL
CERCLIS: TX0001414341
OUID:
SSID: 06GY
Action: RECORD OF DECISION

Region ID: 06
Doc ID: 9216317
Bates: 002790 **To:** 002790
Date: 02/20/2006
Pages: 1
Title: EPA PUBLIC NOTICE OF ISSUED AND ADMINISTRATIVE ORDER ON CONSENT
Doc Type: NOTICE

	Name	Organization
Author:	NONE, NONE	U.S. ENVIRONMENTAL PROTECTION AGENCY
	Name	**Organization**
Addressee:	NONE,	NONE

Region ID: 06
Doc ID: 214637
Bates: 002791 **To:** 002791
Date: 04/04/2006
Pages: 1
Title: [NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION COMMENTS ON DRAFT REMEDIAL INVESTIGATION WORK PLAN FOR STAR LAKE CANAL SITE]
Doc Type: ELECTRONIC RECORD
CORRESPONDENCE

	Name	Organization
Author:	WHITE, JESSICA	U.S. ENVIRONMENTAL PROTECTION AGENCY
	Name	**Organization**
Addressee:	ALLEN, PHILIP	U.S. ENVIRONMENTAL PROTECTION AGENCY

Region ID: 06
Doc ID: 214633
Bates: 002792 **To:** 002794
Date: 04/07/2006
Pages: 3
Title: [EPA COMMENTS ON DRAFT REMEDIAL INVESTIGATIVE REPORT FOR STAR LAKE CANAL]
Doc Type: ELECTRONIC RECORD
MEMORANDUM

	Name	Organization
Author:	SHEWMAKE, KENNETH	U.S. ENVIRONMENTAL PROTECTION AGENCY
	Name	**Organization**
Addressee:	ALLEN, PHILIP	U.S. ENVIRONMENTAL PROTECTION AGENCY

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Site Name: STAR LAKE CANAL
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OUID:
SSID: 06GY
Action: RECORD OF DECISION

Region ID: 06
Doc ID: 214638
Bates: 002795 **To:** 002801
Date: 04/13/2006
Pages: 7
Title: [TCEQ COMMENTS ON REVISED REMEDIAL INVESTIGATION WORK PLAN FOR STAR CANAL SITE]
Doc Type: MEMORANDUM
ELECTRONIC RECORD

	Name	Organization
Author:	SCHREIER, SARAH	TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

	Name	Organization
Addressee:	ALLEN, PHILIP	U.S. ENVIRONMENTAL PROTECTION AGENCY

Region ID: 06
Doc ID: 214636
Bates: 002802 **To:** 002804
Date: 04/14/2006
Pages: 3
Title: [U.S. FISH AND WILDLIFE SERVICE COMMENTS ON REMEDIAL INVESTIGATION WORK PLAN FOR STAR LAKE CANAL]
Doc Type: MEMORANDUM
ELECTRONIC RECORD

	Name	Organization
Author:	FORSYTHE, BARRY	U.S. FISH AND WILDLIFE SERVICE

	Name	Organization
Addressee:	SHEWMAKE, KENNETH	U.S. ENVIRONMENTAL PROTECTION AGENCY

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ADMINISTRATIVE RECORD

Site Name: STAR LAKE CANAL
CERCLIS: TX0001414341
OUID:
SSID: 06GY
Action: RECORD OF DECISION

Region ID: 06
Doc ID: 214655
Bates: 002805 **To:** 002816
Date: 05/16/2006
Pages: 12
Title: RESPONSE TO REMEDIAL INVESTIGATION WORK PLAN REVIEW COMMENTS STAR LAKE CANAL
Doc Type: TABLE
ELECTRONIC RECORD

	Name	Organization
Author:	NONE,	NONE

	Name	Organization
Addressee:	NONE,	NONE

Region ID: 06
Doc ID: 215006
Bates: 002817 **To:** 003180
Date: 06/01/2006
Pages: 364
Title: WORK PLAN REMEDIAL INVESTIGATION OF STAR LAKE CANAL SITE
Doc Type: ELECTRONIC RECORD
WORK PLAN / AMENDMENT

	Name	Organization
Author:	NONE,	ENTRIX INCORPORATED
	NONE,	CONESTOGA-ROVERS & ASSOCIATES

	Name	Organization
Addressee:	NONE,	HUNTSMAN PETROCHEMICAL CORPORATION
	NONE,	CHEVRON ENVIRONMENTAL MANAGEMENT COMPANY

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04/04/2014 **Region ID: 06**

ADMINISTRATIVE RECORD

Site Name: STAR LAKE CANAL
CERCLIS: TX0001414341
OUID:
SSID: 06GY
Action: RECORD OF DECISION

Region ID: 06
Doc ID: 215005
Bates: 003181 **To:** 003182
Date: 06/08/2006
Pages: 2
Title: [TRANSMITTAL OF REVISED WORK PLAN REMEDIAL INVESTIGATION FOR STAR LAKE CANAL SITE]
Doc Type: CORRESPONDENCE
ELECTRONIC RECORD

	Name	Organization
Author:	JACOBSON, GARY	CHEVRON ENVIRONMENTAL MANAGEMENT COMPANY
	Name	**Organization**
Addressee:	ALLEN, PHILIP	U.S. ENVIRONMENTAL PROTECTION AGENCY

Region ID: 06
Doc ID: 215321
Bates: 003183 **To:** 003185
Date: 06/09/2006
Pages: 3
Title: [PROPOSED SAMPLING LOCATIONS FOR STAR LAKE CANAL]
Doc Type: MAP
ELECTRONIC RECORD

	Name	Organization
Author:	NONE,	NONE
	Name	**Organization**
Addressee:	NONE,	NONE

Region ID: 06
Doc ID: 215318
Bates: 003186 **To:** 003187
Date: 06/14/2006
Pages: 2
Title: [REQUEST REGARDING HISTORICAL OR ARCHAEOLOGICAL RECORDS REVIEW FOR STAR LAKE CANAL SITE]
Doc Type: ELECTRONIC RECORD
CORRESPONDENCE
MAP

Name	Organization

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04/04/2014 **Region ID: 06**

ADMINISTRATIVE RECORD

Site Name: STAR LAKE CANAL
CERCLIS: TX0001414341
OUID:
SSID: 06GY
Action: RECORD OF DECISION

	Name	Organization
Author:	MUNICE, CHARLES	CONESTOGA-ROVERS AND ASSOCIATES
	CAMPBELL, PRESSLEY	CONESTOGA-ROVERS AND ASSOCIATES
	Name	**Organization**
Addressee:	GUILLEN, CYNTHIA	TEXAS HISTORICAL COMMISSION

Region ID: 06
Doc ID: 215324
Bates: 003188 **To:** 003189
Date: 07/10/2006
Pages: 2
Title: RESPONSE TO THE REVISED REMEDIAL INVESTIGATION WORK PLAN REVIEW COMMENTS STAR LAKE CANAL SITE
Doc Type: ELECTRONIC RECORD
TABLE

	Name	Organization
Author:	NONE,	NONE
	Name	**Organization**
Addressee:	NONE,	NONE

Region ID: 06
Doc ID: 215339
Bates: 003190 **To:** 003197
Date: 07/12/2006
Pages: 8
Title: SUMMARY AND DOCUMENTATION OF DISCUSSION ON 07/11/2006 REGARDING AMENDED DRAFT REMEDIAL INVESTIGATION WORK PLAN
Doc Type: ELECTRONIC RECORD
MEETING NOTES / MINUTES

	Name	Organization
Author:	NONE,	NONE
	Name	**Organization**
Addressee:	NONE,	NONE

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04/04/2014 **Region ID: 06**

ADMINISTRATIVE RECORD

Site Name: STAR LAKE CANAL
CERCLIS: TX0001414341
OUID:
SSID: 06GY
Action: RECORD OF DECISION

Region ID: 06
Doc ID: 9075763
Bates: 003198 **To:** 003199
Date: 07/12/2006
Pages: 2
Title: [TRANSMITTAL OF SUMMARY AND DOCUMENTATION OF DISCUSSION ON 07/11/2006 REGARDING AMENDED DRAFT REMEDIAL INVESTIGATION WORK PLAN]
Doc Type: ELECTRONIC RECORD
E-MAIL MESSAGE

	Name	Organization
Author:	JACOBSON, GARY	CHEVRON ENVIRONMENTAL MANAGEMENT COMPANY

	Name	Organization
Addressee:	ALLEN, PHILIP	U.S. ENVIRONMENTAL PROTECTION AGENCY

Region ID: 06
Doc ID: 215405
Bates: 003200 **To:** 003203
Date: 07/21/2006
Pages: 4
Title: [TCEQ COMMENTS ON REVISED REMEDIAL INVESTIGATION WORK PLAN FOR STAR CANAL SITE]
Doc Type: CORRESPONDENCE
ELECTRONIC RECORD

	Name	Organization
Author:	SCHREIER, SARAH	TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

	Name	Organization
Addressee:	ALLEN, PHILIP	U.S. ENVIRONMENTAL PROTECTION AGENCY

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Site Name: STAR LAKE CANAL
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Action: RECORD OF DECISION

Region ID: 06
Doc ID: 9216318
Bates: 003204 **To:** 003207
Date: 07/21/2006
Pages: 4
Title: [TCEQ COMMENTS ON REVISED REMEDIAL INVESTIGATION WORK PLAN]
Doc Type: WORK PLAN / AMENDMENT

	Name	Organization
Author:	SCHREIER, SARAH A	TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
Addressee:	ALLEN, PHILIP	U.S. ENVIRONMENTAL PROTECTION AGENCY

Region ID: 06
Doc ID: 9216319
Bates: 003208 **To:** 003209
Date: 08/17/2006
Pages: 2
Title: REVISED REMEDIAL INVESTIGATION WORK PLAN FOR STAR LAKE CANAL SUPERFUND SITE
Doc Type: WORK PLAN / AMENDMENT

	Name	Organization
Author:	CHAVARRIA, GUSTAVIO	U.S. ENVIRONMENTAL PROTECTION AGENCY
Addressee:	CARSTEN, JAY	TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Region ID: 06
Doc ID: 214056
Bates: 003210 **To:** 003210
Date: 08/24/2006
Pages: 1
Title: [EPA APPROVAL OF THE FINAL REMEDIAL INVESTIGATION WORKPLAN SENT TO CHEVRON ENVIRONMENTAL MANAGMENT COMPANY]
Doc Type: CORRESPONDENCE

	Name	Organization
Author:	ALLEN, PHILIP	U.S. ENVIRONMENTAL PROTECTION AGENCY
Addressee:	JACOBSON, GARY	CHEVRON ENVIRONMENTAL MANAGEMENT COMPANY

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04/04/2014 **Region ID: 06**

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Site Name: STAR LAKE CANAL
CERCLIS: TX0001414341
OUID:
SSID: 06GY
Action: RECORD OF DECISION

Region ID: 06
Doc ID: 680750
Bates: 003211 **To:** 003500
Date: 03/16/2007
Pages: 290
Title: ANALYTICAL DATA ASSESSMENT AND VALIDATION REPORT - TIER 1 REMEDIAL INVESTIGATION - STAR LAKE CANAL
Doc Type: REPORT / STUDY
LAB RESULTS
ELECTRONIC RECORD
SAMPLING / ANALYSIS

	Name	Organization
Author:	NONE,	CONESTOGA-ROVERS & ASSOCIATES
	Name	**Organization**
Addressee:	NONE,	NONE

Region ID: 06
Doc ID: 9216320
Bates: 003501 **To:** 003512
Date: 06/11/2007
Pages: 12
Title: TCEQ COMMENTS ON REMEDIAL INVESTIGATION WORK PLAN
Doc Type: CORRESPONDENCE
WORK PLAN / AMENDMENT

	Name	Organization
Author:	SCHREIER, SARAH A	TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
	Name	**Organization**
Addressee:	ALLEN, PHILIP	U.S. ENVIRONMENTAL PROTECTION AGENCY

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04/04/2014 **Region ID: 06**

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Site Name: STAR LAKE CANAL
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OUID:
SSID: 06GY
Action: RECORD OF DECISION

Region ID: 06
Doc ID: 9216321
Bates: 003513 **To:** 003520
Date: 06/25/2007
Pages: 8
Title: [TCEQ ECOLOGICAL RISK ASSESSOR COMMENTS ON REMEDIAL INVESTIGATION WORK PLAN]
Doc Type: CORRESPONDENCE
WORK PLAN / AMENDMENT

	Name	Organization
Author:	SCHREIER, SARAH A	TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
	Name	**Organization**
Addressee:	ALLEN, PHILIP	U.S. ENVIRONMENTAL PROTECTION AGENCY

Region ID: 06
Doc ID: 824924
Bates: 003521 **To:** 003544
Date: 10/01/2007
Pages: 24
Title: COMMUNITY INVOLVEMENT PLAN FOR STAR LAKE CANAL
Doc Type: WORK PLAN / AMENDMENT
ELECTRONIC RECORD

	Name	Organization
Author:	NONE,	U.S. ENVIRONMENTAL PROTECTION AGENCY
	Name	**Organization**
Addressee:	NONE,	NONE

Region ID: 06
Doc ID: 9216322
Bates: 003545 **To:** 003546
Date: 10/31/2007
Pages: 2
Title: [TCEQ RESPONSE TO DRAFT TIER 1 REMEDIAL INVESTIGATION REPORT COMMENTS]
Doc Type: CORRESPONDENCE
WORK PLAN / AMENDMENT

	Name	Organization
Author:	SCHREIER, SARAH A	TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
	Name	**Organization**
Addressee:	ALLEN, PHILIP	U.S. ENVIRONMENTAL PROTECTION AGENCY

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04/04/2014 **Region ID: 06**

ADMINISTRATIVE RECORD

Site Name: STAR LAKE CANAL
CERCLIS: TX0001414341
OUID:
SSID: 06GY
Action: RECORD OF DECISION

Region ID: 06
Doc ID: 665446
Bates: 003547 **To:** 003552
Date: 12/01/2007
Pages: 6
Title: [TCEQ RESPONSE TO THE DRAFT TIER 1 REMEDIAL INVESTIGATION REPORT COMMENTS STAR LAKE CANAL SUPERFUND SITE, JEFFERSON COUNTY, TEXAS]
Doc Type: LIST
ELECTRONIC RECORD
REPORT / STUDY

	Name	Organization
Author:	NONE,	TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
Addressee:	NONE,	NONE

Region ID: 06
Doc ID: 685639
Bates: 003553 **To:** 006301
Date: 02/07/2008
Pages: 2749
Title: [APPENDIX G - ANALYTICAL LABORATORY RESULTS FOR THE STAR LAKE CANAL SUPERFUND SITE]
Doc Type: ELECTRONIC RECORD
REPORT / STUDY
LAB RESULTS
SAMPLING / ANALYSIS

	Name	Organization
Author:	NONE,	LANCASTER LABORATORIES INCORPORATED
Addressee:	NONE,	CHEVRON ENVIRONMENTAL MANAGEMENT COMPANY

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04/04/2014 **Region ID: 06**

ADMINISTRATIVE RECORD

Site Name: STAR LAKE CANAL
CERCLIS: TX0001414341
OUID:
SSID: 06GY
Action: RECORD OF DECISION

Region ID: 06
Doc ID: 685638
Bates: 006302 **To:** 009324
Date: 04/17/2008
Pages: 3023
Title: REVISED DRAFT TIER 1 REMEDIAL INVESTIGATION REPORT FOR STAR LAKE CANAL SUPERFUND SITE
Doc Type: ELECTRONIC RECORD
REPORT / STUDY

	Name	Organization
Author:	NONE,	CONESTOGA ROVERS & ASSOCIATES

	Name	Organization
Addressee:	NONE,	CHEVRON ENVIRONMENTAL MANAGEMENT COMPANY
	NONE,	HUNTSMAN PETROCHEMICAL CORPORATION

Region ID: 06
Doc ID: 680748
Bates: 009325 **To:** 009497
Date: 04/18/2008
Pages: 173
Title: [REVISED FILES FOR DRAFT TIER 1 REMEDIAL INVESTIGATION REPORT - STAR LAKE CANAL, WITH TRANSMITTALS]
Doc Type: ELECTRONIC RECORD
CORRESPONDENCE
REPORT / STUDY

	Name	Organization
Author:	CAMPBELL, PRESSLEY L	CONESTOGA-ROVERS & ASSOCIATES

	Name	Organization
Addressee:	ALLEN, PHILIP	U.S. ENVIRONMENTAL PROTECTION AGENCY

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04/04/2014 **Region ID: 06**

ADMINISTRATIVE RECORD

Site Name: STAR LAKE CANAL
CERCLIS: TX0001414341
OUID:
SSID: 06GY
Action: RECORD OF DECISION

Region ID: 06
Doc ID: 9150003
Bates: 009498 **To:** 009498
Date: 09/19/2008
Pages: 1
Title: SUPERFUND SITE INSPECTION REPORT HURRICANE IKE FOLLOW-UP FOR STAR LAKE CANAL
Doc Type: ELECTRONIC RECORD
FORM

	Name	Organization
Author:	ABSHIRE, CHARLES D	U.S. ENVIRONMENTAL PROTECTION AGENCY

	Name	Organization
Addressee:	NONE,	NONE

Region ID: 06
Doc ID: 9149985
Bates: 009499 **To:** 009501
Date: 09/24/2008
Pages: 3
Title: FEDERAL SUPERFUND SITE INSPECTION FOR HURRICANE IKE RESPONSE - STAR LAKE CANAL
Doc Type: MEMORANDUM
ELECTRONIC RECORD

	Name	Organization
Author:	HAZELWOOD, GARY	TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

	Name	Organization
Addressee:	NONE,	NONE

Region ID: 06
Doc ID: 859072
Bates: 009502 **To:** 009508
Date: 09/26/2008
Pages: 7
Title: [TCEQ COMMENTS ON REVISED DRAFT TIER 2 WORK PLAN FOR STAR LAKE CANAL]
Doc Type: CORRESPONDENCE
ELECTRONIC RECORD

	Name	Organization
Author:	SETTEMEYER, SCOTT	TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

	Name	Organization

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04/04/2014 **Region ID: 06**

ADMINISTRATIVE RECORD

Site Name: STAR LAKE CANAL
CERCLIS: TX0001414341
OUID:
SSID: 06GY
Action: RECORD OF DECISION

	Name	Organization
Addressee:	ALLEN, PHILIP	U.S. ENVIRONMENTAL PROTECTION AGENCY

Region ID: 06
Doc ID: 215075
Bates: 009509 **To:** 009520
Date: 10/14/2008
Pages: 12
Title: RESPONSE TO REMEDIAL INVESTIGATION WORK PLAN REVIEW COMMENTS FOR STAR LAKE CANAL SITE
Doc Type: TABLE
ELECTRONIC RECORD

	Name	Organization
Author:	NONE,	NONE

	Name	Organization
Addressee:	NONE,	NONE

Region ID: 06
Doc ID: 215276
Bates: 009521 **To:** 009524
Date: 10/14/2008
Pages: 4
Title: [U.S. FISH AND WILDLIFE SERVICE AND TEXAS GENERAL LAND OFFICE COMMENTS ON THE REVISED DRAFT REMEDIAL INVESTIGATION WORK PLAN OF THE STAR LAKE CANAL SITE]
Doc Type: ELECTRONIC RECORD
MEMORANDUM

	Name	Organization
Author:	TISCHLER, KEITH	TEXAS GENERAL LAND
	ASH, TAMMY	U.S. FISH AND WILDLIFE SERVICE

	Name	Organization
Addressee:	WHITE, JESSICA	U.S. ENVIRONMENTAL PROTECTION AGENCY

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04/04/2014 **Region ID: 06**

ADMINISTRATIVE RECORD

Site Name: STAR LAKE CANAL
CERCLIS: TX0001414341
OUID:
SSID: 06GY
Action: RECORD OF DECISION

Region ID: 06
Doc ID: 862803
Bates: 009525 **To:** 009526
Date: 03/09/2009
Pages: 2
Title: [APPROVAL OF TIER 2 REMEDIAL INVESTIGATION WORK PLAN]
Doc Type: ELECTRONIC RECORD
CORRESPONDENCE

	Name	Organization
Author:	ALLEN, PHILIP	U.S. ENVIRONMENTAL PROTECTION AGENCY

	Name	Organization
Addressee:	JACOBSON, GARY	CHEVRON ENVIRONMENTAL MANAGEMENT COMPANY

Region ID: 06
Doc ID: 680641
Bates: 009527 **To:** 013451
Date: 05/01/2009
Pages: 3925
Title: FINAL TIER 2 REMEDIAL INVESTIGATION WORK PLAN - STAR LAKE CANAL
Doc Type: WORK PLAN / AMENDMENT
ELECTRONIC RECORD

	Name	Organization
Author:	NONE,	CONESTOGA-ROVERS & ASSOCIATES
	NONE,	ENTRIX ENVIRONMENTAL CONSULTANTS

	Name	Organization
Addressee:	NONE,	HUNTSMAN PETROCHEMICAL CORPORATION
	NONE,	CHEVRON ENVIRONMENTAL MANAGEMENT COMPANY

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04/04/2014 **Region ID: 06**

ADMINISTRATIVE RECORD

Site Name: STAR LAKE CANAL
CERCLIS: TX0001414341
OUID:
SSID: 06GY
Action: RECORD OF DECISION

Region ID: 06
Doc ID: 9404910
Bates: 013452 **To:** 013452
Date: 05/15/2009
Pages: 1
Title: [TRANSMITTAL OF FINAL TIER 2 REMEDIAL INVESTIGATION WORK PLAN - STAR LAKE CANAL]
Doc Type: CORRESPONDENCE

	Name	Organization
Author:	CAMPBELL, PRESSLEY L	CONESTOGA-ROVERS & ASSOCIATES
	EDWARDS, FRANK D	CONESTOGA-ROVERS & ASSOCIATES

	Name	Organization
Addressee:	ALLEN, PHILIP	U.S. ENVIRONMENTAL PROTECTION AGENCY

Region ID: 06
Doc ID: 665447
Bates: 013453 **To:** 013513
Date: 06/12/2009
Pages: 61
Title: WETLAND DELINEATION DATA REPORT FOR THE STAR LAKE CANAL SUPERFUND SITE
Doc Type: REPORT / STUDY
ELECTRONIC RECORD

	Name	Organization
Author:	CAMPBELL, PRESSLEY L	CONESTOGA ROVERS & ASSOCIATES

	Name	Organization
Addressee:	JAYNES, KENNY	U.S. ARMY CORPS OF ENGINEERS

Region ID: 06
Doc ID: 9216323
Bates: 013514 **To:** 013515
Date: 11/20/2009
Pages: 2
Title: [NOTIFICATION OF ASSIGNMENT OF NEW REMEDIAL PROJECT MANAGER FOR STAR LAKE CANAL SUPERFUND SITE]
Doc Type: CORRESPONDENCE
NOTICE

	Name	Organization
Author:	SANCHEZ, CARLOS A	U.S. ENVIRONMENTAL PROTECTION AGENCY

	Name	Organization

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ADMINISTRATIVE RECORD

Site Name: STAR LAKE CANAL
CERCLIS: TX0001414341
OUID:
SSID: 06GY
Action: RECORD OF DECISION

	Name	Organization
Addressee:	JACOBSON, GARY R	CHEVRON TEXACO

Region ID: 06
Doc ID: 9216324
Bates: 013516 **To:** 013521
Date: 11/23/2010
Pages: 6
Title: [TCEQ COMMENTS ON TIER 2 REMEDIAL INVESTIGATION REPORT FOR STAR LAKE CANAL SUPERFUND SITE]
Doc Type: CORRESPONDENCE
WORK PLAN / AMENDMENT
MEMORANDUM

	Name	Organization
Author:	WINSOR, PHILLIP	TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

	Name	Organization
Addressee:	GHOSE, SHAWN	U.S. ENVIRONMENTAL PROTECTION AGENCY

Region ID: 06
Doc ID: 9216325
Bates: 013522 **To:** 013526
Date: 05/19/2011
Pages: 5
Title: [TCEQ COMMENTS ON FINAL TIER 2 REMEDIAL INVESTIGATION REPORT FOR START LAKE CANAL SUPERFUND SITE]
Doc Type: MEMORANDUM
WORK PLAN / AMENDMENT
CORRESPONDENCE

	Name	Organization
Author:	WINSOR, PHILLIP	TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

	Name	Organization
Addressee:	GHOSE, SHAWN	U.S. ENVIRONMENTAL PROTECTION AGENCY

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Site Name: STAR LAKE CANAL
CERCLIS: TX0001414341
OUID:
SSID: 06GY
Action: RECORD OF DECISION

Region ID: 06
Doc ID: 685615
Bates: 013527 **To:** 013537
Date: 05/23/2011
Pages: 11
Title: MEMORANDUM OF AGREEMENT BETWEEN THE NATURAL RESOURCE TRUSTEES AND CHEVRON CONCERNING POTENTIAL EARLY RESTORATION ACTIVITIES ASSOCIATED WITH THE STAR LAKE CANAL
Doc Type: MEMORANDUM
INTERAGENCY AGREEMENT (IAG)
ELECTRONIC RECORD

	Name	Organization
Author:	SMITH, CARTER	TEXAS PARKS AND WILDLIFE DEPARTMENT
	LAINE, LARRY	TEXAS GENERAL LAND OFFICE
	VICKERY, MARK R	TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

	Name	Organization
Addressee:	NONE,	NONE

Region ID: 06
Doc ID: 658945
Bates: 013538 **To:** 013660
Date: 06/01/2011
Pages: 123
Title: ALIGNMENT DOCUMENT FOR THE STAR LAKE CANAL SUPERFUND SITE
Doc Type: REPORT / STUDY
ELECTRONIC RECORD

	Name	Organization
Author:	NONE,	CONESTOGA-ROVERS & ASSOCIATES

	Name	Organization
Addressee:	NONE,	HUNTSMAN PETROCHEMICAL LLC
	NONE,	CHEVRON ENVIRONMENTAL MANAGEMENT COMPANY

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Site Name: STAR LAKE CANAL
CERCLIS: TX0001414341
OUID:
SSID: 06GY
Action: RECORD OF DECISION

Region ID: 06
Doc ID: 9216326
Bates: 013661 **To:** 013663
Date: 06/02/2011
Pages: 3
Title: [EPA AND TCEQ COMMENTS ON THE TIER 2 REMEDIAL INVESTIGATION REPORT FOR THE STAR LAKE CANAL SUPERFUND SITE]
Doc Type: WORK PLAN / AMENDMENT
CORRESPONDENCE

	Name	Organization
Author:	GHOSE, SHAWN	U.S. ENVIRONMENTAL PROTECTION AGENCY

	Name	Organization
Addressee:	JACOBSON, GARY R	CHEVRON TEXACO

Region ID: 06
Doc ID: 650349
Bates: 013664 **To:** 017072
Date: 08/01/2011
Pages: 3409
Title: FINAL TIER 2 REMEDIAL INVESTIGATION REPORT FOR STAR LAKE CANAL
Doc Type: ELECTRONIC RECORD
REPORT / STUDY

	Name	Organization
Author:	NONE,	CHEVRON ENVIRONMENTAL MANAGEMENT COMPANY
	NONE,	CARDNO ENTRIX
	NONE,	HUNTSMAN PETROCHEMICAL LLC
	NONE,	CONESTOGA-ROVERS & ASSOCIATES

	Name	Organization
Addressee:	NONE,	U.S. ENVIRONMENTAL PROTECTION AGENCY

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Site Name: STAR LAKE CANAL
CERCLIS: TX0001414341
OUID:
SSID: 06GY
Action: RECORD OF DECISION

Region ID: 06
Doc ID: 654370
Bates: 017073 **To:** 017088
Date: 11/04/2011
Pages: 16
Title: [SENSITIVITY ANALYSIS-WORKING DOCUMENT USED TO EVALUATE REMEDIAL ALTERNATIVES]
Doc Type: MAP
ELECTRONIC RECORD
MEMORANDUM

	Name	Organization
Author:	NONE,	CARDNO ENTRIX

	Name	Organization
Addressee:	NONE,	NONE

Region ID: 06
Doc ID: 655589
Bates: 017089 **To:** 017099
Date: 12/29/2011
Pages: 11
Title: [SUBMITTAL OF PRELIMINARY EVALUATION OF REMEDIAL ALTERNATIVES FOR FEASIBILITY STUDY - STAR LAKE CANAL SITE]
Doc Type: TABLE
ELECTRONIC RECORD
CORRESPONDENCE

	Name	Organization
Author:	CAMPBELL, PRESSLEY	CONESTOGA-ROVERS & ASSOCIATES
	MUNCE, KATIE M	CONESTOGA-ROVERS & ASSOCIATES

	Name	Organization
Addressee:	GHOSE, SHAWN	U.S. ENVIRONMENTAL PROTECTION AGENCY

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Site Name: STAR LAKE CANAL
CERCLIS: TX0001414341
OUID:
SSID: 06GY
Action: RECORD OF DECISION

Region ID: 06
Doc ID: 655703
Bates: 017100 **To:** 017110
Date: 12/29/2011
Pages: 11
Title: PRELIMINARY EVALUATION OF REMEDIAL ALTERNATIVES
Doc Type: TABLE
CORRESPONDENCE
ELECTRONIC RECORD

	Name	Organization
Author:	MUNCE, KATIE M	CONESTOGA-ROVERS & ASSOCIATES
	CAMPBELL, PRESSLEY	CONESTOGA-ROVERS & ASSOCIATES
	Name	**Organization**
Addressee:	GHOSE, SHAWN	U.S. ENVIRONMENTAL PROTECTION AGENCY

Region ID: 06
Doc ID: 651827
Bates: 017111 **To:** 017113
Date: 02/03/2012
Pages: 3
Title: [EPA RESPONSE TO PRELIMINARY EVALUATION OF REMEDIAL ALTERNATIVES AND THE PROPOSED PROJECT SCHEDULE]
Doc Type: CORRESPONDENCE
ELECTRONIC RECORD
FACSIMILE / COVER SHEET

	Name	Organization
Author:	GHOSE, SHAWN	U.S. ENVIRONMENTAL PROTECTION AGENCY
	Name	**Organization**
Addressee:	JACOBSEN, GARY	CHEVRON ENVIRONMENTAL MANAGEMENT COMPANY

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Site Name: STAR LAKE CANAL
CERCLIS: TX0001414341
OUID:
SSID: 06GY
Action: RECORD OF DECISION

Region ID: 06
Doc ID: 9216327
Bates: 017114 **To:** 017116
Date: 02/22/2012
Pages: 3
Title: [TCEQ COMMENTS ON THE STAR LAKE CANAL FEASIBILITY STUDY WORK PLAN]
Doc Type: WORK PLAN / AMENDMENT
E-MAIL MESSAGE

	Name	Organization
Author:	CHAMPAGNE, LARRY	TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
Addressee:	SHEWMAKE, KENNETH	U.S. ENVIRONMENTAL PROTECTION AGENCY

Region ID: 06
Doc ID: 9216328
Bates: 017117 **To:** 017118
Date: 05/03/2012
Pages: 2
Title: [COMMENTS ON THE DRAFT FEASIBILITY STUDY REPORT FOR THE START LAKE CANAL SUPERFUND SITE]
Doc Type: CORRESPONDENCE
WORK PLAN / AMENDMENT

	Name	Organization
Author:	SMITH, MICHAEL	TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
Addressee:	GHOSE, SHAWN	U.S. ENVIRONMENTAL PROTECTION AGENCY

Region ID: 06
Doc ID: 662016
Bates: 017119 **To:** 017140
Date: 06/01/2012
Pages: 22
Title: COMMUNITY INVOLVEMENT PLAN - STAR LAKE CANAL
Doc Type: WORK PLAN / AMENDMENT
ELECTRONIC RECORD

	Name	Organization
Author:	NONE,	U.S. ENVIRONMENTAL PROTECTION AGENCY
Addressee:	NONE,	NONE

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ADMINISTRATIVE RECORD

Site Name: STAR LAKE CANAL
CERCLIS: TX0001414341
OUID:
SSID: 06GY
Action: RECORD OF DECISION

Region ID: 06
Doc ID: 685383
Bates: 017141 **To:** 017475
Date: 06/08/2012
Pages: 335
Title: FINAL FEASIBILITY STUDY REPORT FOR STAR LAKE CANAL SUPERFUND SITE
Doc Type: REPORT / STUDY
ELECTRONIC RECORD

	Name	Organization
Author:	CAMPBELL, PRESSLEY L	CONESTOGA ROVERS & ASSOCIATES

	Name	Organization
Addressee:	GHOSE, SHAWN	U.S. ENVIRONMENTAL PROTECTION AGENCY

Region ID: 06
Doc ID: 660505
Bates: 017476 **To:** 017477
Date: 06/12/2012
Pages: 2
Title: [TRANSMITTAL OF THE FINAL FEASIBILITY STUDY REPORT FOR STAR LAKE CANAL SUPERFUND SITE]
Doc Type: CORRESPONDENCE
REPORT / STUDY
ELECTRONIC RECORD

	Name	Organization
Author:	CAMPBELL, PRESSLEY L	CONESTOGA ROVERS & ASSOCIATES

	Name	Organization
Addressee:	GHOSE, SHAWN	U.S. ENVIRONMENTAL PROTECTION AGENCY

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ADMINISTRATIVE RECORD

Site Name: STAR LAKE CANAL
CERCLIS: TX0001414341
OUID:
SSID: 06GY
Action: RECORD OF DECISION

Region ID: 06
Doc ID: 660503
Bates: 017478 **To:** 017478
Date: 06/20/2012
Pages: 1
Title: APPROVAL LETTER FOR THE STAR LAKE CANAL FINAL FEASIBILITY STUDY WORK PLAN
Doc Type: CORRESPONDENCE
ELECTRONIC RECORD

	Name	Organization
Author:	WINSOR, PHILLIP	TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

	Name	Organization
Addressee:	GHOSE, SHAWN	U.S. ENVIRONMENTAL PROTECTION AGENCY

Region ID: 06
Doc ID: 659320
Bates: 017479 **To:** 017813
Date: 06/30/2012
Pages: 335
Title: [FEASIBILITY STUDY FOR STAR LAKE CANAL SUPERFUND SITE]
Doc Type: REPORT / STUDY
ELECTRONIC RECORD

	Name	Organization
Author:	NONE,	CARDNO ENTRIX
	NONE,	CONESTOGA-ROVERS & ASSOCIATES

	Name	Organization
Addressee:	NONE,	HUNTSMAN PETROCHEMICAL LLC
	NONE,	CHEVRON ENVIRONMENTAL MANAGEMENT COMPANY

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ADMINISTRATIVE RECORD

Site Name: STAR LAKE CANAL
CERCLIS: TX0001414341
OUID:
SSID: 06GY
Action: RECORD OF DECISION

Region ID: 06
Doc ID: 672931
Bates: 017814 **To:** 017814
Date: 11/13/2012
Pages: 1
Title: EPA WELL APPROVAL LETTER TO WILLIAMS MIDSTREAM - STAR LAKE CANAL
Doc Type: ELECTRONIC RECORD
CORRESPONDENCE

	Name	Organization
Author:	GHOSE, SHAWN	U.S. ENVIRONMENTAL PROTECTION AGENCY
	Name	**Organization**
Addressee:	TERRAZAS, RAY	WILLIAMS MIDSTREAM

Region ID: 06
Doc ID: 682176
Bates: 017815 **To:** 017815
Date: 03/01/2013
Pages: 1
Title: PROGRESS REPORT - DOCKET NO. 06-02-06 - MARCH 2013 - STAR LAKE CANAL
Doc Type: ELECTRONIC RECORD
REPORT / STUDY

	Name	Organization
Author:	NONE,	NONE
	Name	**Organization**
Addressee:	NONE,	NONE

Region ID: 06
Doc ID: 685711
Bates: 017816 **To:** 017817
Date: 05/01/2013
Pages: 2
Title: PROGRESS REPORT MAY 2013 - DOCKET NO. 06-02-06 - STAR LAKE CANAL
Doc Type: ELECTRONIC RECORD
REPORT / STUDY

	Name	Organization
Author:	NONE,	NONE
	Name	**Organization**
Addressee:	NONE,	NONE

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04/04/2014 **Region ID: 06**

ADMINISTRATIVE RECORD

Site Name: STAR LAKE CANAL
CERCLIS: TX0001414341
OUID:
SSID: 06GY
Action: RECORD OF DECISION

Region ID: 06
Doc ID: 683869
Bates: 017818 **To:** 017821
Date: 05/14/2013
Pages: 4
Title: [SUBMITTAL OF RECOMMENDATIONS REGARDING PROPOSED WORK TO CLEAR ADJACENT LAND FOR DRAINAGE PURPOSES - TRACKING NO. 7012 1640 0000 4346 1687 - STAR LAKE CANAL]
Doc Type: CORRESPONDENCE
ELECTRONIC RECORD

	Name	Organization
Author:	BELL, CASEY A	RICHARDS RODRIGUEZ & SKEITH LLP

	Name	Organization
Addressee:	BARRON, EVE	CHEVRON U.S.A. INCORPORATED

Region ID: 06
Doc ID: 685385
Bates: 017822 **To:** 017886
Date: 06/01/2013
Pages: 65
Title: PROPOSED PLAN STAR LAKE CANAL SUPERFUND SITE
Doc Type: ELECTRONIC RECORD
REPORT / STUDY

	Name	Organization
Author:	NONE,	TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

	Name	Organization
Addressee:	NONE, NONE	U.S. ENVIRONMENTAL PROTECTION AGENCY

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Site Name: STAR LAKE CANAL
CERCLIS: TX0001414341
OUID:
SSID: 06GY
Action: RECORD OF DECISION

Region ID: 06
Doc ID: 685384
Bates: 017887 **To:** 017888
Date: 06/06/2013
Pages: 2
Title: [TRANSMITTAL OF THE FINAL FEASIBILITY STUDY REPORT FOR STAR LAKE CANAL SUPERFUND SITE]
Doc Type: ELECTRONIC RECORD
CORRESPONDENCE

	Name	Organization
Author:	CAMPBELL, PRESSLEY L	CONESTOGA-ROVERS & ASSOCIATES
	Name	**Organization**
Addressee:	GHOSE, SHAWN	U.S. ENVIRONMENTAL PROTECTION AGENCY

Region ID: 06
Doc ID: 685626
Bates: 017889 **To:** 017893
Date: 06/06/2013
Pages: 5
Title: FINAL FEASIBILITY STUDY REPORT REVISED PAGES - CERCLA DOCKET NO. 06-02-06 - STAR LAKE CANAL
Doc Type: CORRESPONDENCE
TABLE

	Name	Organization
Author:	CAMPBELL, PRESSLEY L	CONESTOGA-ROVERS & ASSOCIATES
	Name	**Organization**
Addressee:	MILLER, GARY	U.S. ENVIRONMENTAL PROTECTION AGENCY

Region ID: 06
Doc ID: 9424155
Bates: 017894 **To:** 017897
Date: 06/10/2013
Pages: 4
Title: PROPOSED PLAN FACT SHEET - JUNE 2013 - STAR LAKE CANAL SUPERFUND SITE
Doc Type: FACTSHEET
ELECTRONIC RECORD

	Name	Organization
Author:	NONE, NONE	U.S. ENVIRONMENTAL PROTECTION AGENCY
	Name	**Organization**

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ADMINISTRATIVE RECORD

Site Name: STAR LAKE CANAL
CERCLIS: TX0001414341
OUID:
SSID: 06GY
Action: RECORD OF DECISION

	Name	Organization
Addressee:	NONE,	NONE

Region ID: 06
Doc ID: 9419693
Bates: 017898 **To:** 017898
Date: 06/17/2013
Pages: 1
Title: [TRANSMITTAL OF MEMORANDUM OF AGREEMENT BETWEEN THE NATURAL RESOURCE TRUSTEES AND CHEVRON CONCERNING POTENTIAL EARLY RESTORATION ACTIVITIES ASSOCIATED WITH THE STAR LAKE CANAL]
Doc Type: ELECTRONIC RECORD
CORRESPONDENCE
E-MAIL MESSAGE

	Name	Organization
Author:	MILLER, GARY G	U.S. ENVIRONMENTAL PROTECTION AGENCY

	Name	Organization
Addressee:	NEAL, DOROTHY	U.S. ENVIRONMENTAL PROTECTION AGENCY

Region ID: 06
Doc ID: 685812
Bates: 017899 **To:** 017930
Date: 06/19/2013
Pages: 32
Title: PROPOSED PLAN ADMINISTRATIVE RECORD INDEX FOR STAR LAKE CANAL SUPERFUND SITE
Doc Type: INDEX
ELECTRONIC RECORD

	Name	Organization
Author:	MILLER, GARY	U.S. ENVIRONMENTAL PROTECTION AGENCY
	NONE,	TOEROEK ASSOCIATES INCORPORATED

	Name	Organization
Addressee:	NONE,	NONE

ADMINISTRATIVE RECORD INDEX

04/04/2014 **Region ID: 06**

ADMINISTRATIVE RECORD

Site Name: STAR LAKE CANAL
CERCLIS: TX0001414341
OUID:
SSID: 06GY
Action: RECORD OF DECISION

Region ID: 06
Doc ID: 686564
Bates: 017931 **To:** 017931
Date: 06/21/2013
Pages: 1
Title: [NOTICE OF PROPOSED PLAN AND PUBLIC COMMENT PERIOD - MEETING 07/11/2013 - STAR LAKE CANAL]
Doc Type: NOTICE

	Name	Organization
Author:	NONE,	NONE
	Name	**Organization**
Addressee:	NONE,	NONE

Region ID: 06
Doc ID: 688758
Bates: 017932 **To:** 017932
Date: 07/01/2013
Pages: 1
Title: PROGRESS REPORT - JULY 2013 - STAR LAKE CANAL
Doc Type: ELECTRONIC RECORD
REPORT / STUDY

	Name	Organization
Author:	NONE,	CONESTOGA-ROVERS & ASSOCIATES
	Name	**Organization**
Addressee:	NONE, NONE	U.S. ENVIRONMENTAL PROTECTION AGENCY

Region ID: 06
Doc ID: 687884
Bates: 017933 **To:** 017983
Date: 07/11/2013
Pages: 51
Title: [TRANSCRIPT OF THE 07/11/2013 PROPOSED PLAN PUBLIC MEETING FOR STAR LAKE CANAL]
Doc Type: PUBLIC MEETING TRANSCRIPT

	Name	Organization
Author:	NONE,	U.S. LEGAL SUPPORT INCORPORATED
	Name	**Organization**
Addressee:	NONE,	NONE

ADMINISTRATIVE RECORD INDEX

04/04/2014 **Region ID: 06**

ADMINISTRATIVE RECORD

Site Name: STAR LAKE CANAL
CERCLIS: TX0001414341
OUID:
SSID: 06GY
Action: RECORD OF DECISION

Region ID: 06
Doc ID: 690881
Bates: 017984 **To:** 017984
Date: 08/01/2013
Pages: 1
Title: PROGRESS REPORT - DOCKET NO. 06-02-06 - AUGUST 2013 - STAR LAKE CANAL
Doc Type: REPORT / STUDY
ELECTRONIC RECORD

	Name	Organization
Author:	NONE,	NONE
	Name	**Organization**
Addressee:	NONE,	NONE

Region ID: 06
Doc ID: 693085
Bates: 017985 **To:** 018144
Date: 09/30/2013
Pages: 160
Title: RECORD OF DECISION FOR STAR LAKE CANAL SUPERFUND SITE
Doc Type: ELECTRONIC RECORD
RECORD OF DECISION / AMENDMENT

	Name	Organization
Author:	NONE,	U.S. ENVIRONMENTAL PROTECTION AGENCY
	Name	**Organization**
Addressee:	NONE,	NONE

Region ID: 06
Doc ID: 708983
Bates: 018145 **To:** 018145
Date: 09/30/2013
Pages: 1
Title: [TCEQ CONCURANCE LETTER FOR THE STAR LAKE CANAL SUPERFUND SITE RECORD OF DECISION]
Doc Type: CORRESPONDENCE
ELECTRONIC RECORD

	Name	Organization
Author:	COVAR, ZAK	TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
	Name	**Organization**

ADMINISTRATIVE RECORD INDEX

04/04/2014 **Region ID: 06**

ADMINISTRATIVE RECORD

Site Name: STAR LAKE CANAL
CERCLIS: TX0001414341
OUID:
SSID: 06GY
Action: RECORD OF DECISION

	Name	Organization
Addressee:	EDLUND, CARL	U.S. ENVIRONMENTAL PROTECTION AGENCY